

The **AMSAT**[®] Journal



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Looking for a simple way to build an Az-El rotator system?
Shown here are Tony's (AA2TX) antennas with his inexpensive rotators. He shows you how on page 10.

Drew Glasbrenner, KO4MA, uses his hand-held equipment to demonstrate satellite operation to an onlooking crowd of hams at a Florida hamfest. More about Drew is on page 19.



AMSAT-NA
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Periodicals

POSTAGE PAID

At Silver Spring, MD
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How You Can Help Build New and Exciting Satellites

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Bequest

A codicil in your will, naming The Radio Amateur Satellite Corporation as a beneficiary will help insure the continuance of the Amateur Radio Satellite program.

Call the AMSAT-NA office at 301-589-6062 for questions on any or all of these ways you can help build new and exciting satellites.

Support AMSAT-NA

AMSAT-UK Announces New Satellite Transponder Project

AMSAT-UK is delighted to be able to announce its participation in the SSETI ESEO satellite project. ESEO - The European Student Earth Orbiter is a satellite planned for launch in late 2008 into a geo-stationary transfer orbit similar to the initial orbit of AO-40 and to those planned for Eagle and P3E.

In December 2005 two AMSAT-UK members were invited to attend a SSETI Workshop at the European Space Agencies ESTEC facility in the Netherlands. This workshop, which lasted a week, had over eighty students in attendance from more than twenty universities around Europe.

The involvement of the AMSAT-UK team with the project was confirmed at the Workshop and the team were elected as "Honorary Members" of the SSETI Association in appreciation of their work

supporting the previous SSETI Express project.

The prime communications system for ESEO is being developed by the University of Wroclaw in Poland and will operate on "commercial" S-Band space frequencies. It will provide all the usual telecommand and telemetry facilities and use standard ESA CCSDS packet communication techniques.

ESEO also has a need for a redundant communications system - one that can operate in the event of a primary system failure but can also function satisfactorily if and when the spacecraft is not in its intended earth-pointing mode. This is where AMSAT is planning to assist.

The current project calls for a unit that can receive telecommands from earth on UHF (435MHz), transfer those to the OBC via

continued on page 9 ...

AMSAT's Mission

AMSAT is a non-profit volunteer organization which designs, builds and operates experimental satellites and promotes space education. We work in partnership with government, industry, educational institutions and fellow Amateur Radio societies. We encourage technical and scientific innovation, and promote the training and development of skilled satellite and ground system designers and operators.

AMSAT's Vision

Our Vision is to deploy high earth orbit satellite systems that offer daily coverage by 2009 and continuous coverage by 2012. AMSAT will continue active participation in human space missions and support a stream of LEO satellites developed in cooperation with the educational community and other amateur satellite groups.





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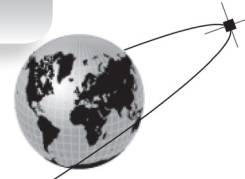
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APOGEE VIEW

by Rick Hambly, W2GPS • w2gps@amsat.org



AMSAT continues to expand its operational and developmental activities. AMSAT is moving forward with the P3E and Eagle projects with a strong sense of purpose and with a commitment to engineering and scientific excellence. The international fleet of AMSAT and other low earth orbit satellites continues to work well and ARISS activity is at a high level. To support AMSAT's P3E and Eagle development our fund raising activities, both within AMSAT and outside, are beginning to bear fruit.

It is particularly pleasing to see a significant increase in the amount of voice activity between the general AMSAT community and the International Space Station (ISS). The ARISS team reported that "Bill McArthur, KC5ACR, has already earned his Worked All Continents award on VHF. Over the January 14 - 15 weekend he became the first ISS crew member to complete his Worked All Continents on UHF. He needs two states (Missouri and Alaska) to qualify for the Worked All States award and has over half the countries needed for his DXCC award. Some recent countries contacted were Algeria, Serbia and Montenegro, Kyrgyzstan, Azores, Cuba and Malaysia. William McArthur has made over 700 contacts to the amazement of the ham radio community."

Development work on P3E and Eagle continues at a strong pace. The development teams are compensating for the physical diversity of the members by using the latest communications and Internet tools. The teams have set up roundtable Internet voice meetings using the AMSAT Engineering channel on the ham radio TeamSpeak Server run by Eric Ellison, AA4SW. Small groups and pairs of team members around the world are able to reach each other for free (or very low cost) using the Internet voice Skype service, which has fantastic audio quality. We also use a standard phone line teleconference bridge donated by Alliance Healthcare thanks to the efforts of AMSAT's Secretary, Steve Diggs, W4EPI.

For non-voice Eagle team communications we are using the EaglePedia service on the AMSAT Web server that was set up by Emily Clarke, N1DID, as well as the more traditional Eagle e-mail list. EaglePedia is a very powerful Web-based team collaboration tool based on the same software that powers Wikipedia (www.wikipedia.org) called "MediaWiki". It is

open source and is 100% compatible with our server environment. Using this tool, team members can post meeting and trip reports, engineering drawings, software, pictures and other documentation while cross-referencing material and categorizing it for fast retrieval. Team members can even edit each other's work to provide instant feedback and editorial corrections. Every change is tracked and can be backed out, if necessary. I hope that we will soon be able to expose this new section of our Web site so everyone can have read-only access and will be able to use EaglePedia to watch the development of Eagle in near real time.

Recently I have been asked by a university team to carry their payloads on future AMSAT satellites. These payloads are typically interesting pure science payloads that have relevance to AMSAT, such as ionospheric and radiation experiments. The data from such experiments would be freely available to all in a downlink telemetry channel. This is not the first such request but it was made early enough in the development cycle to allow the university to seek funding for both the payload and for a share of the satellite and launch costs. Some of these opportunities would fit Eagle's "This Space for Rent" (TSFR) module space and others would require building more AO-51 class satellites. In either case, it is an interesting way for AMSAT and the universities to work more closely in the future and I will keep the membership informed if anything develops from these contacts.

Please help AMSAT-NA to hatch Eagle. To make this happen, AMSAT needs YOUR active financial support. The Eagle Team can't build these satellites without having the dollars needed to fund construction. Add to this the cost of launching a satellite into HEO and it becomes clear that AMSAT must raise a minimum of \$150,000 in 2006 with higher amounts in 2007 and beyond. You may respond to our direct mailing, which you received some time ago, go to the AMSAT Web store via our Web site at www.amsat.org or call Martha in the office at (301) 589-6062. Please note that donations of \$120.00 or more qualify for President's Club status where you may elect to have your

Apogee View - continues on page 15



AMSAT Eagle Update

James A. Sanford, PE, WB4GCS, wb4gcs@amsat.org
Eagle Project Manager



Our Vision is to deploy high earth orbit satellite systems that offer daily coverage by 2009 and continuous coverage by 2012 ...

Many events and a great deal of effort have transpired since my last report to you.

The first engineering model of a standard payload module has been produced. Figures 1 and 2 show this model, which will be evaluated.

Shortly after Thanksgiving a meeting was held in New Jersey to kick off earnest design work on our RF payloads. Attendees were:

- Rick Hambly, W2GPS
- Tom Clark, K3IO
- Bob McGwier, N4HY
- Paul Drexler, W2PED
- Matt Ettus, N2MJI
- Marc Franco, N2UO
- Jan King, W3GEY/VK3GEY
- Paul Wade, W1GHZ
- Marc Zaharchuk, WA3CRM
- John Stephensen, KD6OZH
- Al Katz, K2UYH
- Steve Henderson (no call)

Assignments were made for detailed follow on design efforts which are in progress. One outcome of the New Jersey meeting was a commitment for access to an RF laboratory in NJ. This will give us space, access to leading edge test and development equipment and

significant products of this meeting. First, P3E management decided to fly the Software Defined Transponder (SDX) on P3E. This means that SDX development efforts will benefit both projects and that Eagle will benefit from experience gained in the P3E flight as our prototype. Second, some improvements to the CAN bus, which will be used for inter-module communications on P3E and Eagle, were developed. These improvements reduce the power consumed and improve the single fault tolerance of the bus and entire spacecraft. In general, knowledge sharing between the two teams was advanced by this meeting, to all our benefit.

The design of the SDX continues and is shown in Figure 3 (next page). If you examine it closely you'll see many functions relegated to a Field Programmable Gate Array, or FPGA. Our reasons for using such devices are the same as in industry. Specific functions have been allocated to the FPGA such as reset strategy, memory Error Detection and Correction (EDAC) and various interface functions. The FPGA has been tested (by others) and is radiation tolerant. The selected Digital Signal Processor (Texas Instruments 320C6701) has been tested in Cobalt-60 and

a description of the environment we face see Steve Bible's presentations from the Pittsburgh meeting, also on the Web site.

Some promising new sensors have been discussed. Some of them will allow us to measure things we've had to previously infer or calculate. As the sensor package design evolves we'll publish detailed information for information and evaluation.

There has been a protracted discussion within the Eagle team regarding failure modes, mitigation strategies and general fault tolerance. The results of these discussions are starting to be reflected in design proposals. The proposed system architecture of the SDX allows both versatility in operations and useful user services in the event of a single module or device failure, for example.

As a project the Eagle design is moving from concept definition and elaboration to concept analysis and testing. Some hardware, IHU-3 and CAN-Do!, has been rigorously tested. Rigorous modeling, simulation and analysis are being applied to other components. As the hard science leads us to explicit conclusions we will make changes to the design. This is to be expected and I expect the rate of change

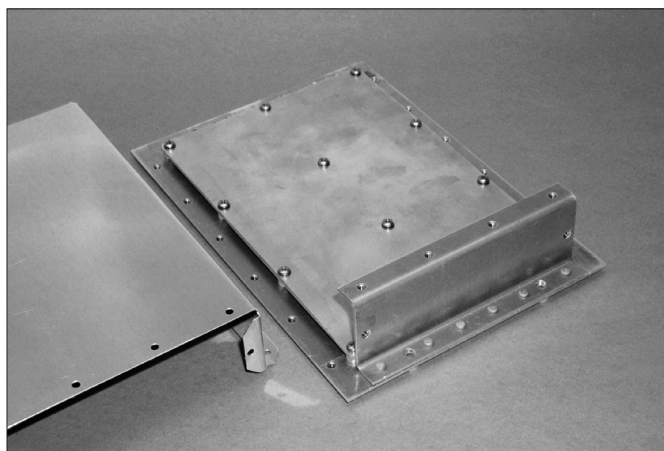


Figure 1

a small pool of college student volunteers. This is important because it helps us build Eagle and fulfills an AMSAT strategic goal of reaching out to universities and colleges for both talent and labor.

Another meeting took place in Marburg, Germany between the P3E team and Bob, N4HY, et al. There were several

neutron radiation environments. Samples were tested to various exposure levels and to failure. Below the failure threshold, there was no statistically measurable degradation. These tests suggest that the selected devices will survive 10 to 15 years in the radiation environment we expect. Information on these tests is on the AMSAT Web site. For

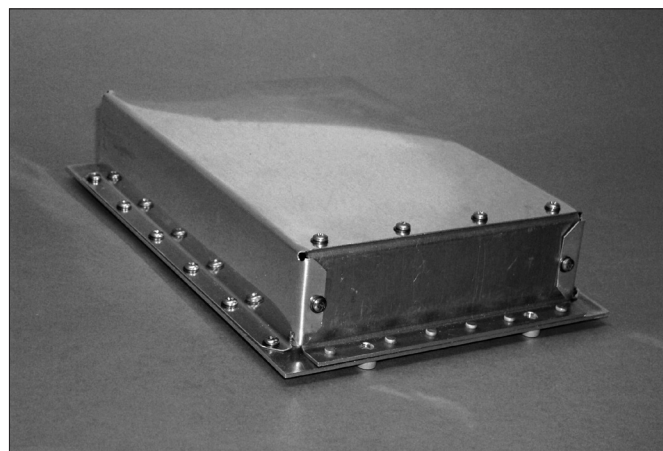


Figure 2

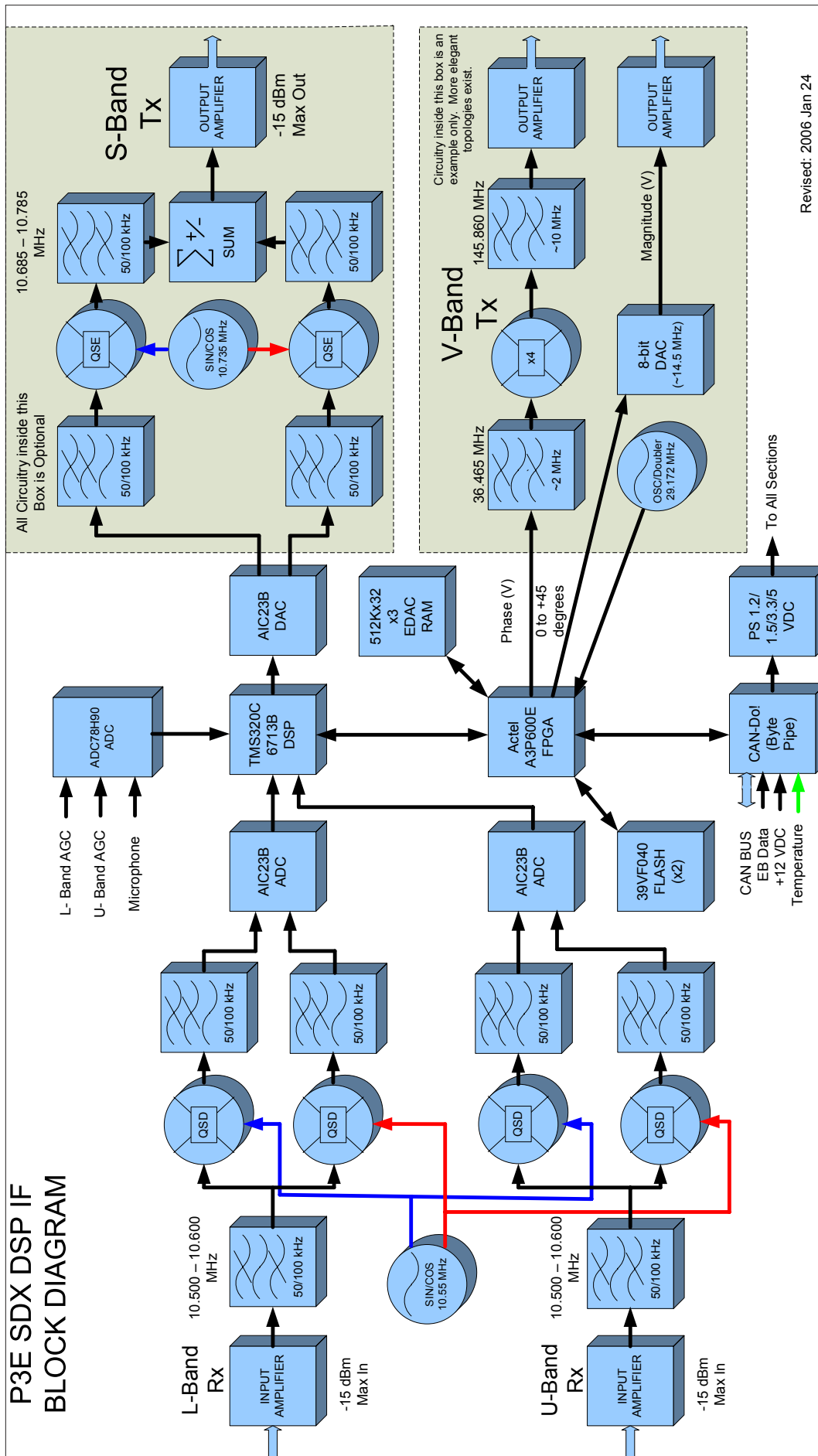
to increase over the next several months as concepts evolve toward a real-world design. Stay tuned to the *Journal*, the AMSAT Web site and ANS for the latest information as the Eagle design is refined.

Thanks for your support.

As always, comments and questions to: wb4gcs@amsat.org ☺

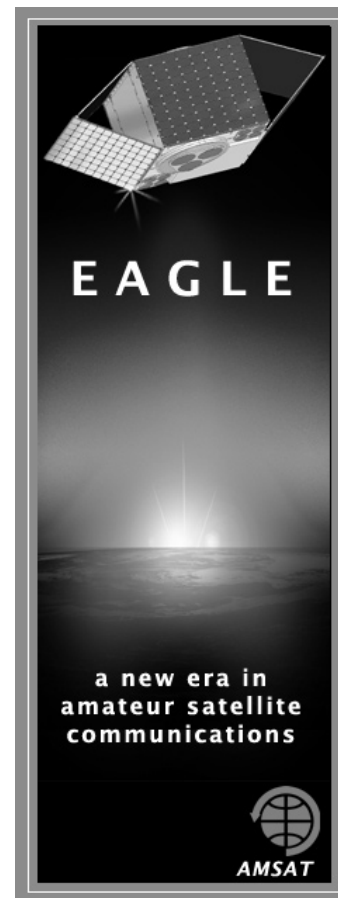


P3E SDX DSP IF BLOCK DIAGRAM



Revised: 2006 Jan 24

Figure 3
Block diagram of the Software Defined Transponder planned to fly on P3E.



Caribbean Cruise Satellite Operation a Success

Allen F. Mattis, N5AFV, n5afv@amsat.org

Introduction

I had the wonderful opportunity to operate the FM LEO satellites while on a Caribbean cruise December 17-27, 2005. The cruise departed Port Everglades, FL and sailed to the island of Dominica in the Lesser Antilles and back to Port Everglades. Amateur Radio operation was conducted at sea as a maritime mobile and at six ports of call.

Previous experience operating on cruises [1], [4] helped me prepare for this cruise and its successful Amateur Radio satellite operation. All contacts were made on AO-27, SO-50 and AO-51 using an Icom W32A HT and an AL800 telescoping antenna. This equipment has become my preferred choice when operating on cruises [2], [3].

[4]. On this particular cruise, my US license covered operation from Puerto Rico and the US Virgin Islands. I also have a reciprocal license from the Bahamas, which was the first port of call and where the ship was flagged. Another port of call was the French island of St Bartholomew and the CEPT convention gave me instant operating privileges there. Obtaining licensing for the remaining two ports of call was more challenging.

The British Virgin Islands application procedure for a reciprocal Amateur Radio license (<http://www.qsl.net/oh2mcn/vp2v.htm>) appeared to be easy to follow, and I prepared to submit my application. Copies of both my passport identification page and my FCC Amateur Radio license had to be notarized as being true copies and

Ministry of Communications & Works by e-mail and explain that I planned to visit the British Virgin Islands in a few weeks and needed the license issued before my cruise sailed. The license arrived by mail ten days later.

Obtaining a reciprocal Amateur Radio license for Dominica appeared to be straightforward when I looked at the information on the ARRL Web site (http://www.arrl.org/FandES/field/regulations/io/recipe-info_a.html#j7). I submitted an application according to the Web site instructions and later sent an e-mail to the licensing authorities to inquire about the progress of my application. I received a reply by e-mail informing me that my call sign would be J79AFV and that I should pick up my license at their office when I arrived in Dominica. I checked satellite pass times for my stop in Dominica and realized that there would be a satellite pass before I had time to pick up my license. I inquired by e-mail about obtaining permission to operate before picking up my license and I received a reply by e-mail that authorized me to operate as J79AFV for one year beginning November 16, 2005. When I arrived in Dominica, I began operating immediately. Later in the afternoon, I went to the National Telecommunications Regulatory Commission office to pick up my license. I was informed that my license had been sent to the customs office at the dock where I landed and that I should pick it up there. I picked up the license on my way back to the ship and it was then I found out that

Location	AO-27		SO-50		AO-51		Totals	
	Passes	Contacts	Passes	Contacts	Passes	Contacts	Passes	Contacts
At Sea - Maritime Mobile	8	56	6	28	10	64	24	148
Nassau, Bahamas	2	10	2	12	0	0	4	22
San Juan, Puerto Rico	1	2	1	4	0	0	2	6
St Thomas, USVI	1	2	1	4	2	5	4	11
Roseau, Dominica	2	9	1	8	1	6	4	23
Gustavia, St Bartholomew	1	7	1	5	2	15	4	27
Roadtown, Tortolla, BVI	0	0	1	4	2	20	3	24
Totals	15	86	13	65	17	110	45	261

Figure 1

Summary of satellite passes and contacts by location, N5AFV cruise December 17-27, 2005

Summary Statistics

While on the cruise, a total of 45 satellite passes were worked and 261 contacts were made (Figure 1). Amateur Radio satellite operation was conducted on all three of the active FM LEO satellites (Figure 2). Contacts were made with Amateur Radio stations in 27 US states, 4 Canadian provinces, 3 Mexican states, as well as Guadeloupe, Martinique, Puerto Rico and Venezuela. I also heard a Brazilian station but was unable to make a contact with him. The average number of contacts made per satellite pass was 5.8. Contacts at sea as a maritime mobile comprised 57% of the total contacts and 43% of the total contacts were made while in port. This was the first cruise where I made an effort to operate from all ports of call.

Discussion

Obtaining licenses for operation from the various ports of call on a cruise can take a great deal of time and advance planning

an application form had to be filled out. I also submitted an international money order in the amount of \$20.10. However,

Satellite	At Sea - Maritime Mobile		In Ports of Call		Total Cruise	
	Passes	Percent	Passes	Percent	Passes	Percent
AO-27	8	33%	7	33%	15	33%
SO-50	6	25%	7	33%	13	29%
AO-51	10	42%	7	33%	17	38%
Totals	24	100%	21	100%	45	100%

Figure 2

Summary of satellite passes and contacts by satellite, N5AFV cruise December 17-27, 2005

because it was in the second half of the year, the correct fee was \$10.10. I was not aware that British Virgin Islands reciprocal Amateur Radio licenses are issued for the calendar year and expire on December 31st. This \$10 overpayment delayed issue of the license. I was able to contact the office of the Telecommunications Manager in the

the call sign issued to me had been changed to J79AFM. Local Amateur Radio operators in Dominica usually receive a J73 call sign with their initials as the suffix, and reciprocal operators usually receive a J79 call sign with their home call sign suffix. My initials are AFM and this was done as a favor to me. The

... continued on page 8



A 'KISS' Satellite Station Getting on AO-7, FO-29 and VO-52 the Simple Way

By Ray Soifer, W2RS, w2rs@amsat.org

The OSCAR station described here is about as far from state-of-the-art as it is possible to get and still have it work. Virtually everything about it can be improved upon – better antennas, lower noise figures, etc. I even wrote many of those station-improvement articles myself. So why did I write this one? I keep hearing so often, from so many people, how complicated and difficult it is to get on the linear-transponder satellites – currently AMSAT-OSCAR 7, Fuji-OSCAR 29 and VUSat-OSCAR 52 – so I want to show how easy and inexpensive it can be. The following is a true story.

During 2005 I sold my house in New Jersey and began moving W2RS into my house in Green Valley, Arizona that I had purchased the previous year. I expect the process to go on for a long time: what ham station is ever really finished? Be that as it may, December found me with Straight Key Night on OSCAR coming up and no satellite antennas other than the Arrow hand-held beam and MFJ-1717 whip that I've been using with hand-helds on the FM birds. Not an acceptable situation, by any means! How to get a home-based CW station onto the linear-transponder satellites quickly and easily became the order of the day.

From the New Jersey QTH I brought most of the station equipment I would need, all of it relatively ancient but still working: Icom IC-290A and IC-490A multi-mode transceivers for 145 and 435 MHz, respectively, as well as a Mirage B1016 2m amp and a Tokyo Hy-Power HL-90U amp for 70cm. As driven by their respective transceivers the two amps measured 150 and 70 watts output, respectively. There's nothing magic about any of this equipment except that I happened to have it already. Whatever you have or can beg or borrow will probably work too, if it's even roughly comparable.

One caution concerning equipment, however: if you plan on using a single transceiver to cover both the 145 and 435 MHz bands, be sure it is capable of listening on one band while transmitting on the other. Being able to hear your own downlink is highly desirable, but not absolutely essential, on the FM satellites. It's critical, however, to have this capability when operating CW or SSB through a linear transponder.

Now for the KISS part – the antenna. What could be simpler than a 19-inch 2m/70cm mag-mount whip? At a hamfest, I picked up a new one. It happened to be a Pro-Am MO144-440 with a matching mount. In the catalogs, the combo is listed at \$47, but the hamfest was ending soon and the dealer was happy to part with it for \$30. A friend with an extension ladder (I don't climb anything higher than two feet) put it on the roof for me. Actually, he plopped it on top of my house's rooftop heating/AC unit, which is about four feet square and provides a good ground plane. Also, my heating/AC unit is not far from the shack, so a long run of coax isn't required. The longer the coax, the more loss.

There's nothing magic about that particular antenna model either. Just be sure that the one you use will handle the power you want to run. You can find lots of longer antennas, with more gain, but for reasons we will discuss shortly, I do not recommend them for this purpose. A 19-inch dual-band whip is just about right for a KISS satellite station.

Now wait a minute, you say. Don't ground plane antennas such as that have a null at the zenith, and aren't satellites up in the sky? Don't you need an upward-pointing antenna? I'll let you in on the dirty little secret of elevation rotors and all that complicated stuff. With low-earth-orbit (LEO) satellites such as the ones listed above, most of the time you don't really need to elevate your antenna at all unless it's got a lot of gain.

The specifics will vary slightly with your latitude and the orbital inclination, but a satellite in approximately polar orbit at an altitude of 800-900 km, such as FO-29 and VO-52, will have an elevation angle of 60° or more only about 1% of the time it is within sight of your station. Its elevation will exceed 30° only about 10% of the time it is within range. Even AO-7, at an orbital altitude of 1500 km, will have an elevation angle of 60° or more only about 2% of the time.

I've had my KISS mag-mount whip up and running for a month now and it provides good coverage of satellite passes when the elevation angle is between roughly 10° and 60°. A longer whip, with more gain, wouldn't get coverage as high as 60° elevation.

The lower the elevation angle, the farther away the satellite is from your station and signal strength varies inversely with the square of the distance. So, for low elevation angles, substantial antenna gain is required. To get reliable coverage below 10° elevation, you would generally want a beam of some sort. Depending upon terrain, my Arrow hand-held beam can work satellite passes down to about 4° or so, while the long yagis at my old QTH could get down to 1°. You cannot point a beam from the comfort of your shack without a rotator, however, so it fails the KISS test. With our KISS antenna, you don't even have to know in which direction the satellite is, as long as it's within range.

What about Faraday rotation? Yes, I do notice some nulls from time to time, when the signal to or from the satellite is horizontally polarized. Most of the time, though, that's not a problem. Satellites nowadays receive and transmit mostly elliptical polarization so there is usually enough vertically-polarized signal to get through. Besides, fixing Faraday rotation entirely would require you to have switchable polarization at your antennas, which also fails the KISS test.

As you've probably gathered by now, there ain't no free lunch in the satellite biz either. In return for using so simple an antenna system, we are in effect giving up access to the satellite for roughly half the time when it is in sight – at elevation angles below 10° or above 60°, and the relatively few times when the polarization is purely horizontal. But isn't 50% satellite access better than 0%?

If you're fortunate enough to have a radio that covers both bands (145 and 435 MHz) with full-duplex operation through a single antenna connector, you may not need anything more than that dual-band antenna. However, since I have a separate transceiver for each band, I needed one more piece of equipment to bring my KISS satellite station to life, a duplexer. I saw a few at the hamfest, but they were of uncertain parentage and power-handling capacity. So, I decided to splurge and ordered a Diamond MX-72N, which is rated at 150 watts CW on 145 MHz and 100 watts CW on 435 MHz. That set me back another \$50 but my KISS satellite station is now complete. The duplexer works



... continued from previous page

surprisingly well with very little desensing of the 435 MHz receiver while transmitting on 145 MHz, even with 150 watts output.

At my QTH, I found the receiving preamplifiers built into the two “brick” amps to be quite adequate to hear the satellites even through the duplexer and approximately 40 feet of coax. If you have a long run of cable or an especially noisy receiver, you may find that you need an antenna-mounted preamp, particularly on 435 MHz. That would require mounting the duplexer at the antenna, placing the preamp in the 435 MHz line, and running two coax cables down from the roof. (Be sure that the transmit/receive switching system in the preamp is capable of handling your power level.) However, placing the duplexer in the shack and using just one coax cable to the antenna works well for me.

So how did my KISS station do in Straight Key Night on OSCAR? Great! I worked five SKN stations on FO-29, three on AO-7 and two on VO-52. I’ve been enjoying satellite passes with it ever since. See you on the birds! 📶



Figure 3
KP4/N5AFV working KE4AZN on SO-50 from El Moro, San Juan National Historic Site, Puerto Rico

Cruisin’ the Satellites ... continued from page 6

contacts I made using the call sign J79AFV are valid; I just used an incorrect call sign while operating those passes. This incident illustrates some of the complications that can arise with Amateur Radio licensing in foreign countries.

When I was as far east as I would get on the cruise, I worked a number of east passes hoping to make a contact across the Atlantic Ocean. Even though I was not able to make a trans-Atlantic contact, those passes did yield some very enjoyable results. On two east passes I had very nice conversations with Mark, VO1ONE, in Newfoundland. On another east pass, I enjoyed a four-way round table with Rony, FG5FU, Julien, FM0HN, and Pedro, YV6PM. These east passes are clear examples of one of the primary purposes of Amateur Radio as described in FCC Part 97.1(e): “Continuation and extension of the amateur’s unique ability to enhance international goodwill.”

Conclusion

Operation on the satellites during this

cruise was very enjoyable. The Amateur Radio operators on the satellites were very courteous, which allowed a high number of contacts to be made. I look forward to operating on another cruise in the future.

References:

1. Mattis, Allen, 2003, Prior planning - key to a successful DX cruise: *The AMSAT Journal*, May/June (Volume 26, No. 3), pp 24-26, (reprinted from *Worldradio*, 2002, April, p. 18-21).
2. Mattis, Allen, 2005, HT and AL800 Antenna – An Excellent Portable Satellite Station: *The AMSAT Journal*, March/April (Volume 28, No. 2), p. 21-23.
3. Mattis, Allen, 2005, A Postscript to HT and AL800 Antenna – An Excellent Portable Satellite Station: *The AMSAT Journal*, May/June (Volume 28, No. 3), p. 17.
4. Mattis, Allen, 2005, Satellites and Cruising – A Winning Combination, *Proceedings of the AMSAT-NA 23rd Space Symposium*, p 128-138. 📶



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a CAN bus. Additionally, it must transmit telemetry and mission data to the ground on S-Band (2.4 GHz). We are planning to use omni-directional antenna systems so the data rate will necessarily be quite low although output power will be approximately 9 watts.

When in orbit, it is likely that the student experiments will be completed within a few weeks to months from launch after which time it will become available as a linear U/S mode transponder. The ESEO spacecraft will have a rectangular structure and a mass of 120kg. The solar panels will be deployable and steerable while the propulsion system will use nitrogen gas. The 50 kHz wide mode U/S transponder will be switchable from a conventional linear design to a fully digital design based on DSP techniques using the G6LVB STELLA firmware. Two UHF canted monopoles on opposite ends of the spacecraft will be used to receive signals on U band. The S-Band output of 9 Watts will feed two turnstiles or quadrilifal helixes. As well as the transponder, the unit will also provide 400 bps BPSK telemetry in AO-40 format. Obviously we cannot expect the transponded signals on the ground to be as strong as we enjoyed from AO-40 but they should provide worldwide communication similar to the earlier AO-13 project.

The AMSAT-UK team includes G4DDK, G7OCD, G6LVB, G0MRF, & G3VZV who were responsible for the S-Band transmitter on SSETI Express.

This new opportunity to participate in this exciting venture is very much a result of the impressive support that the amateur fraternity around the world gave to the SSETI Express project - so thank you and congratulations!

We can also report the good news that a student team from the Technical University of Budapest has been added to the SSETI program to work on the on-board Electrical Power System. This team, under the leadership of Dr. Andras (Bandi) Gschwindt, HA5WH, has masterminded similar systems on AO-10, AO-13 and AO-40 all of which have proven to be extremely successful.

More news will be published as soon as it becomes available through the usual channels. At the time of writing the SSETI ESEO Web pages are not up-to-date but new information is being added regularly, so please check <http://www.sseti.org>

AMSAT is the North American distributor of SatPC32, a tracking program designed for ham satellite applications. For Windows 95, 98, NT, ME, 2000, XP.

Version 12.4 now supports Labjack U12 and W0LMD rotor controllers and Doppler tuning for Yaesu FT-817/857/897.

Features:

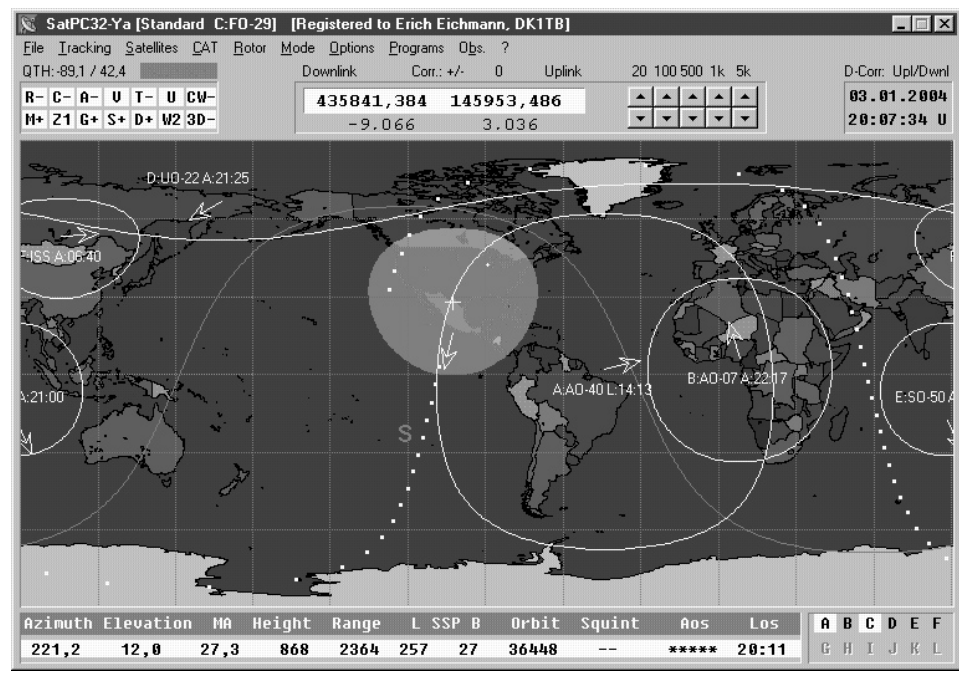
- Version 12.4 also supports automatic Internet download of Keplerian elements.
- Graphical tracking on a world map with two selectable Zoom factors.
- One-click satellite switching using 12 "letter" buttons.
- Automatic rotor control support for: Kansas City Tracker/Tuner, FODtrack, Uni-Trac, SatEL, Labjack U12/Piggyback, W0LMD Mini/Junior/Senior Trackers, Yaesu GS-232, ARS from EA4TX, EGIS rotors, IF-100, RIF-PC, AMSAT-DL interface, WinRotor32, HalloRotor, and WiSP DDE clients.
- Doppler tuning with on-screen frequency displays. Radio models supported:
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The author DK1TB donated SatPC32 to AMSAT. All proceeds support AMSAT.



Control your Antennas with a Digital Potentiometer

by Anthony Monteiro, AA2TX, AA2TX@amsat.org

Introduction

Automatic antenna tracking makes working the amateur satellites much easier, especially on fast moving LEO[1] satellites. But automatic tracking requires a computer rotor-control interface and this has generally been expensive to buy or fairly complex for a homebrew project. This article describes an alternative approach that uses only a single chip and is very easy to construct. The chip costs \$1.59[2] and the total cost of the parts is about \$5.

This interface was implemented on an azimuth/elevation satellite tracking system made from ORBIT-360 TV antenna rotators but the same approach could be used to

sites at very low prices.

Unfortunately, the ORBIT-360s were not designed for computer control and they have no provisions for it. But, they use a feedback potentiometer at the rotor to provide positioning information and this makes it easy to build a simple and low-cost computer interface for them. The key to this low-cost interface is a device called a digital potentiometer.

Digital Potentiometer

A digital potentiometer (pot) is a resistor with an adjustable tap just like the familiar volume control. But, unlike a volume control, the tap on a digital pot is adjusted via a digital interface rather than a knob.

The device used in this rotor interface is a Microchip MCP41010, a 10K ohm pot with a built-in Serial Peripheral Interface (SPI.) SPI was invented by Texas Instruments as a simple and low-cost way for a micro-controller to communicate with its peripheral devices. Fortunately, the SPI signal levels

wiper value byte. The blocks are clocked synchronously into the chip from the SI lead on positive transitions of the SCK signal.

The diagram in Figure 2 illustrates how the SPI protocol works. To start the data transfer, the NCS signal is set low. The SI lead is set to the most significant data bit value and the SCK signal is pulsed high to clock in the bit. Then the next most significant data bit value is put on the SI lead and the SCK signal is again pulsed high to clock in this bit. After all 16 bits are clocked in, the NCS lead goes high to transfer the data value to the pot wiper. For further details, please refer to the specification sheet from Microchip[5]. The MCP41010 will ignore any data blocks that have the wrong number of bits and this provides a high level of noise immunity. The chip also has Schmitt-trigger inputs on the SPI leads to further increase its noise immunity.

How it Works

The ORBIT-360 control box implements a *closed-loop, automatic control system*. A block diagram of it is shown in Figure 3. The control pot on the top of the control box is used to set the desired antenna direction. The feedback pot in the rotor unit is gear-driven by the same motor that turns the antenna. The wiper on each pot forms a voltage divider from the +4.5VDC source. Each of the wipers is fed to an input of the difference amplifier circuit.

The difference amplifier compares the voltages from the two pots and generates an error signal, which is fed to the motor driver circuit. When the error signal exceeds a minimum threshold, the motor driver activates the motor, turning it either clockwise or counter clockwise depending upon the polarity of the error signal. As the motor turns, the wiper on the feedback pot moves in tandem so that eventually,



Figure 1
Satellite tracking antenna system

provide a computer interface on any antenna rotator system that uses a potentiometer for positioning feedback[3] including the Yaesu G-5400/5500/5600 units.

The ORBIT-360 was one of the most popular TV antenna rotators ever made. They were sold by Walmart, Home Depot and almost every major electronics retailer in the USA. In addition to their low cost, a great feature of these units is that the antenna mast passes through the body of the rotor making it easy to use one mounted horizontally for elevation control.

A pair of ORBIT-360 rotors can easily handle moderate sized beams and a 1-meter dish. My antenna system with a 2.4 GHz dish and a 70 cm panel antenna[4] is shown in Figure 1. While no longer manufactured, used and re-built ORBIT-360 units are not hard to find and new-old-stock units can often be found on popular on-line auction

are compatible with the signal levels on a PC parallel port. With a little bit of software to implement the communications protocol, the SPI digital pot can be controlled from a PC with no extra hardware.

The SPI protocol on the MCP41010 chip uses three signals, *Not Chip Select* (NCS,) *Serial Clock* (SCK,) and *Serial Input* (SI.) The SPI data blocks are 16-bits long and include an 8-bit command byte and an 8-bit

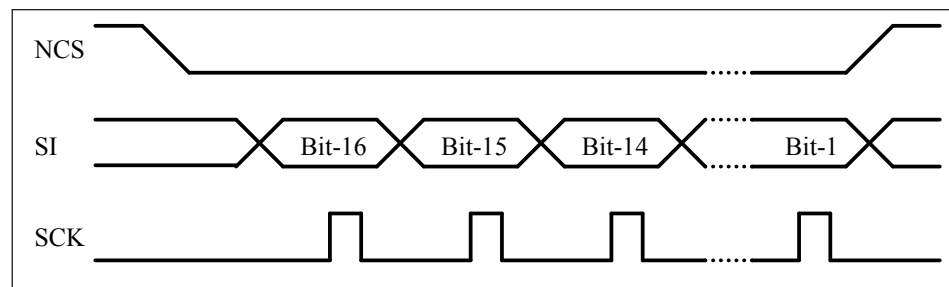


Figure 2
SPI Protocol Operation

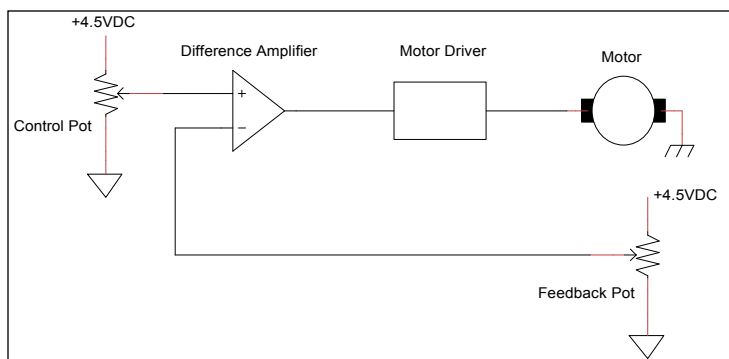


Figure 3
ORBIT-360 control system

the feedback pot wiper and the control pot wiper will have the same output voltage. At that point the error signal will go below the minimum threshold and the motor driver will shut off the motor. The antenna is then pointing in the direction that was set by the control pot.

To make the ORBIT-360 computer controlled, all that is needed is to replace the manually-operated control pot with a digital pot. The digital pot is wired in parallel

leads if the cable is disconnected from the computer. While not used on the prototype models, 100 ohm resistors may be added in series with the SPI signals for additional static protection if the units will be used where significant static electric discharge is a problem.

To install the computer interface, the pc trace from the control pot wiper to the difference amplifier must be cut and a switch is added to select either the control pot wiper or the

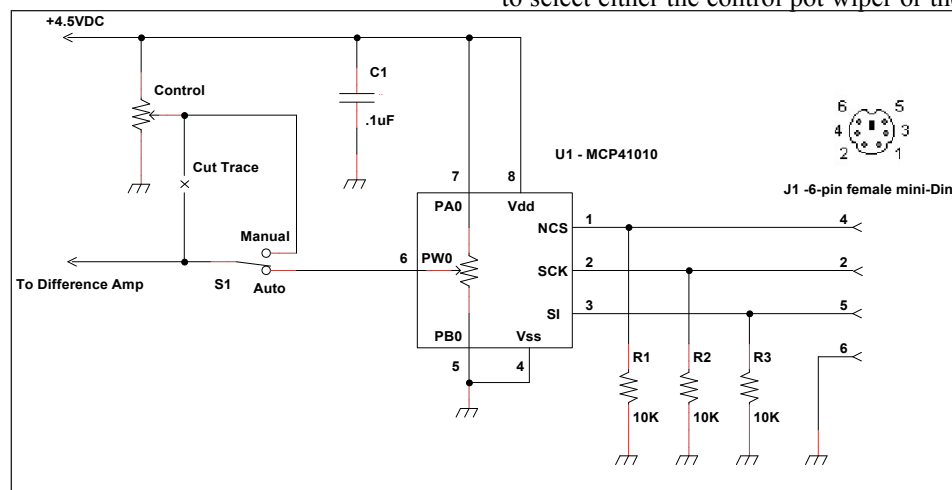


Figure 4
Computer interface schematic

with the control pot and a switch is used to select the wiper of either the control pot or the digital pot allowing either manual or computer control.

Circuit Description

Rather than build an external box, the computer interface was built right into the rotor control box, eliminating the need for any power supply, printed circuit board or enclosure. The computer interface on the rotor control box is directly connected to the PC parallel port with a cable. The circuit schematic diagram is shown in Figure 4 and the parts list for the interface is in Table 1. Note that a full Az/El system requires two interfaces, one for each control box.

digital pot wiper. This trace and cut is shown in Figure 5. The +4.5V and ground signals are also available right at the control pot leads making it easy to connect the interface. The modified unit can still operate stand-alone by switching to the manual control pot.

The digital pot, resistors and the capacitor easily fit on the pc board of the ORBIT-360 controller. Holes were drilled in the controller board for the discrete components and an 8-pin DIP socket was installed for the digital pot. The switch was mounted on the top panel of the control box and the parts were wired with 30-gauge wire-wrap wire.

The SPI signals on the digital pot are wired to a 6-pin mini-DIN connector that is installed at the rear of the control box. This connector is the same type used for the PS/2 mouse and keyboard on many PCs. The three 10K resistors pull down the SPI

A photo of the completed controller board is shown in Figure 6. The 8-pin DIP on the right of the control pot is the difference amplifier, a uA741 op-amp. The 8-pin DIP on the left is the digital pot with its associated components.

The interface cable wiring is shown in Figure 7. This cable can be easily made by cutting a standard, male-to-male, PS/2 keyboard-extender cable in half and soldering the wires to a DB-25 female connector. This eliminates the need to solder the 6-pin mini-DIN male connectors, which can be a challenge given their small size.

Software

All of the software and source code is in the file *irotor.zip* that is available from the AMSAT Web site[6] The software was tested and operated properly under DOS-5, Windows3.1, Windows95 and WindowsXP. The software package includes the following components; *Digipot.exe*, *RotorDRV.exe*, *Rotor.exe*, *Park.bat* and *Source.zip*.

Digipot.exe is a simple DOS program that will control a Microchip MCP41010 or MCP4050 digital pot. It is intended to allow experimenting with these devices which can be both fun and educational. You can use digital pots to control many types of electronic circuits well beyond the simple rotor interface described in this article. To use the program, wire the digital pot NCS, SCK, and SI leads (pins 1, 2 and 3) to your PC parallel port connector pins 2, 3 and 4 respectively and connect the circuit ground to pin 18 on the parallel port connector. *Digipot.exe* defaults to using port 1 but it can drive any standard parallel port by specifying the port number on the command line.

RotorDRV.exe is a TSR[7] driver for the rotor interface that is compatible with the Kansas City Tracker[8] specification. When

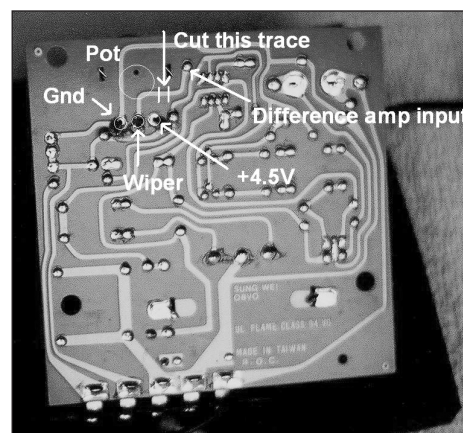


Figure 5
Bottom of unmodified controller board



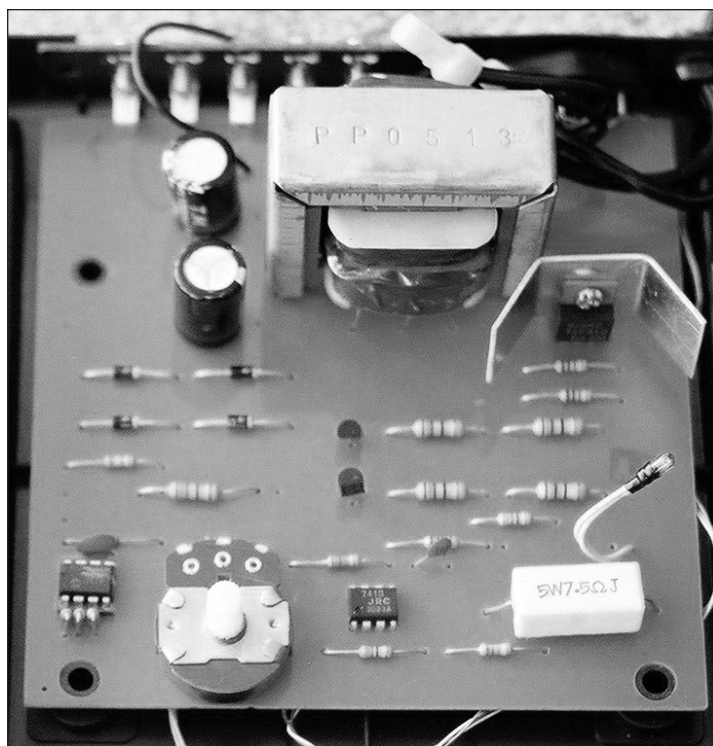


Figure 6
Modified controller board

installed, it uses only 6K of memory and can control azimuth-only or Az/El rotor systems. It was designed for and has been tested with the *InstantTrack* satellite tracking software available from AMSAT[9].

Rotor.exe is a command line control program for the *RotorDRV.exe* TSR. It is mostly intended for testing the rotor interface and software installation but also includes a helpful "flip antennas" feature that causes the elevation rotor to operate beyond 90 degrees (i.e. with the antennas flipped over.) This is useful when a satellite pass would cause the azimuth rotor to hit up against the end stop. *Rotor.exe* will provide all of the commands and options for itself and for *RotorDRV.exe* by typing "Rotor" at the DOS prompt.

Park.bat is a DOS batch file that will park

Component	Description
C1	0.1uF, 50V ceramic disc capacitor
J1	6-pin, mini-Din jack
R1, R2, R3	10K ohm, ¼ watt resistor
S1	SPDT sub-miniature toggle switch
U1	MCP41010, Microchip digital pot

Table 1
Parts list

the rotors with the antennas pointing straight up. It can be easily modified using a text editor such as Notepad or WordPad to set the parking position to wherever is desired.

done by typing "rotordrv.exe" plus any options at the DOS prompt or it can be put into a batch file for convenience. Next, load any other TSR drivers that you usually use (such as OrbitDRV or *InstantTune*[10]) and then start *InstantTrack*. When you select a satellite and hit the "r" key to start tracking, the rotor control boxes will light up showing that the rotors are moving to track the satellite. Once they are pointing at the correct azimuth and elevation, the lights will go out. As the satellite pass progresses, the lights will flash when one of the rotors is moved to track the satellite. This system will track a satellite to within about 2 degrees which is more than sufficient for pointing a 1-meter dish at 2.4 GHz. The *RotorDRV* software will automatically suspend rotor movement if the satellite elevation goes below -5 degrees.

Summary

Digital potentiometers are very useful and provide an incredibly easy way to control an analog circuit from a PC. The rotor interface

Source.zip is the source code for the *Digipot.exe*, *RotorDRV.exe* and *Rotor.exe* programs.

The software modules include a parallel port driver, an SPI digital pot driver and a rotor controller. Anyone who wants to write their own software for the rotor interface or for controlling digital pots is welcomed and encouraged to use the source code.

Operation with InstantTrack

To use the rotor driver you have to load it into memory first. This can be

described in this article was built for about \$5 using a handful of commonly available parts. Although simple and inexpensive, this rotor interface provides all the hardware needed for fully automatic antenna tracking and greatly simplifies operating on the ham satellites.

References:

1. LEO: *Low Earth Orbit*
2. MCP41010 is listed at \$1.59 each at Jameco Electronics; www.jameco.com
3. TV antenna rotators with 3-wire connections do not use a pot and will not work with this circuit
4. *A Panel Reflector Antenna for 70cm*, by Anthony Monteiro, AA2TX, QST Feb 2005.
5. Microchip spec sheets can be found at www.microchip.com
6. irotor.zip software is available at www.amsat.org
7. TSR: *Terminate and Stay Resident* program, a way to effect hardware drivers under DOS
8. The Kansas City Tracker interface spec is available from AMSAT at www.amsat.org
9. *InstantTrack* is available from AMSAT at www.amsat.org
10. *InstantTune* automatic radio tuning software is available for free from AMSAT at www.amsat.org

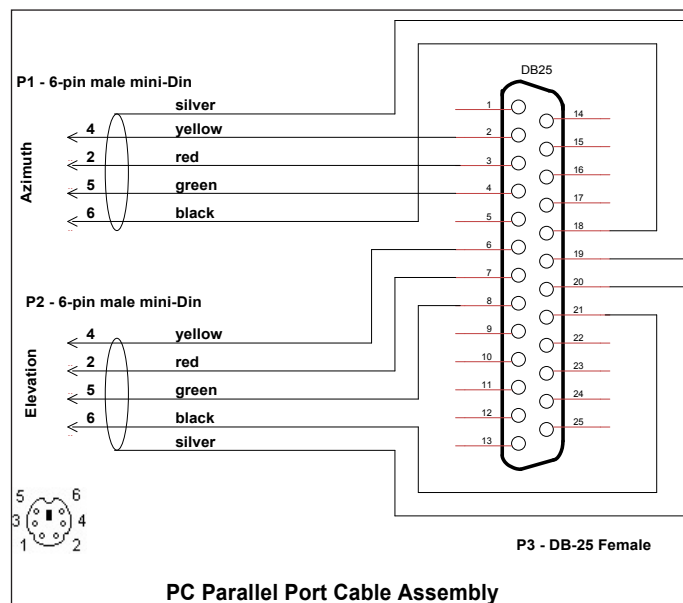
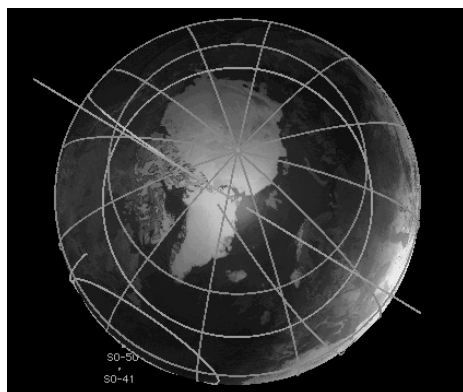


Figure 7
Interface cable wiring

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SARA members or supporters wishing to present a paper should e-mail a letter of intent, including a proposed title and informal abstract or outline (not to exceed 100 words) to the SARA vice president at vicepres@radio-astronomy.org, no later than 1 March 2006. Be sure to include your full name, affiliation, postal address, and e-mail address, and indicate your willingness to attend the conference to present your paper. Submitters will receive an e-mail response, typically within one week, along with a request to proceed to the next stage, if the proposal is consistent with the planned program. A formal Proceedings will be published in conjunction with this meeting. Papers will be peer-reviewed by a panel of SARA members with appropriate professional expertise and academic credentials. First draft manuscripts must be received no later than 1 April 2006, with feedback, acceptance or rejection e-mails to be sent within two weeks thereafter. Upon final editing of accepted papers, camera-ready copy will be due not later than 1 May 2006. Due to printer's deadlines, manuscripts received after that deadline will not make it into the Proceedings. Instructions for preparation of final manuscripts will be e-mailed to the authors of all accepted papers.

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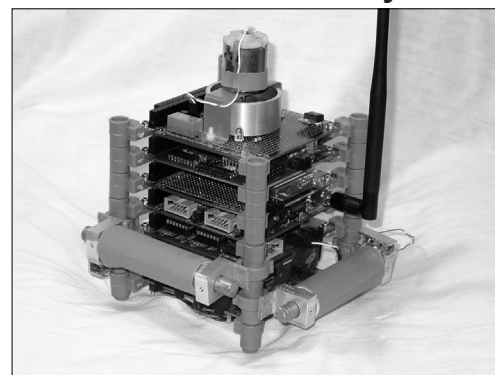
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Apogee View - continued from page 3

donation payment spread over 12 months using your credit card as well as receive a special President's Club pin in recognition for your support of Eagle. Your generous contribution to AMSAT will help ensure that our common dream will indeed become a reality.

73,
Richard M. Hambly, W2GPS
AMSAT President ☺

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2005 Small Satellite Conference and CubeSat Workshop

Lee McLamb, KU4OS, ku4os@amsat.org

The 19th annual American Institute of Aeronautics and Astronautics (AIAA) Conference on Small Satellites will once again be held at the Utah State University (USU) campus in Logan, UT[1]. The 2005 conference was held November 8-11 with a CubeSat[2] workshop held during the weekend prior. For the last several years various members of AMSAT have attended and represented AMSAT at the conference which has an annual attendance of about 600 people. This conference provides an opportunity to meet with others who, like AMSAT, are also building small satellites. Many of these are university groups which are planning to utilize the amateur satellite service for their command and telemetry frequencies and are looking for advice from AMSAT and even suggestions on how to make their satellites more useful to the general amateur community. This directly supports the portion of AMSAT's Vision which states, "and support a stream of LEO satellites developed in cooperation with the educational community and other amateur satellite groups".

Cubesat Workshop

The CubeSat workshop was held Saturday afternoon, a full day on Sunday and concluded Monday morning. During the workshop Saturday afternoon, Jan King, VK4GEY/W3GEY, presented an update and explanation of the process for coordinating amateur satellite frequencies through the IARU. Jan also discussed the orbital debris issue and again encouraged everyone to start paying more attention to the regulatory environment. He made a point of the fact that AMSAT is continually involved with the FCC on satellite related issues and there is a need for the CubeSat community to support AMSAT's efforts.

Another presentation made on Saturday was by Kyle Schroeder who explained the Florida University Satellite (FUNSAT) competition[3] that was held last year and announced that they would be kicking off a second competition later this fall which is expanding to include several states in the Southeast USA. He also acknowledged and thanked AMSAT for the support they had received during their first competition.

On the second day there were several "Seminar Sessions" which provided an interactive forum for discussion. Jan King and Cliff Buttschardt, K7RR, conducted the

"Comm/Earthstation Subsystem" session. A lot of good information was passed along to the CubeSat teams who are frequently eager for assistance with the radio portion of their projects. During this session Jan demonstrated the new link budget spreadsheets[4], which were very well received.

SmallSat Conference

This was the first year that AMSAT participated in the conference as an exhibitor. Having a table location with the AMSAT banner prominently displayed was a big improvement this year. It made us much more visible and made it easier for people to find us. The location was very good as we were near the university exhibits and also somewhat separated from the large and very expensive commercial exhibits. Included with our table space registration a 150 word description of AMSAT was provided in the Conference Program and the AMSAT Annual Report was included with materials in the media press kits sent out by the Conference.

One of the challenges of the Smallsat conference is the duration. Al Zoller, N7UB, Nick Pugh, K5QXJ, and Cliff Buttschardt, K7RR, were a great help in keeping the table manned throughout the 2½ day exhibit. Al also helped by bringing the materials for the table with him from Montana, Nick provided a second notebook computer and Cliff provided a CubeSat model from Cal Poly in addition to spending many hours actually helping keep the table staffed.

During the conference we distributed an updated package of material via thumb-drives which contained spreadsheets on link, power and mass budgets, background information from the IARU and a collection of informative presentations originally assembled by Tom Clark, K3IO (ex. W3IWI) and Art Feller, W4ART.

One of the benefits of attending the conference is that AMSAT has the opportunity to learn about other satellite projects that are being planned. Another benefit is being able to sit down with groups of students and assist them in planning their projects. The response to AMSAT's help has been steadily improving. One such example is the FASTRAC team from University of Texas at Austin[5]. One of their questions was how they could make

their spacecraft useful to the general amateur community after the initial 90-100 day experiment was completed.

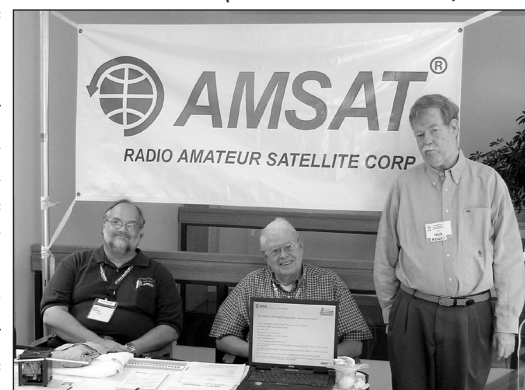
There also is considerable overlap in attendance between this conference and the Rideshare Conference hosted by Goddard Spaceflight Center and the National Reconnaissance Office. By being represented at both conferences it improves our ability to network and have AMSAT be seen as an active participating member of the small satellite community.

I greatly enjoyed this year's conference and again want to thank Al, Nick, Cliff and Jan for all their assistance this year. It reinforced by experience that many of these schools and projects need help in the areas where we as AMSAT members have our greatest strength, building ground stations and operating radios. Take a look at the list of schools working on CubeSats on the Web site listed in the notes[2]. Is one close to you? I think you'll also be amazed at how fun you can have working with these energetic and motivated students.

References:

1. AIAA/USU Small Satellite Conference, www.smallsat.org
2. CubeSat Program, www.cubesat.org
3. Lee McLamb, KU4OS, "Florida University Satellite Competition", *The AMSAT Journal*, July/August 2005
4. <http://www.amsat.org.uk/iaru/spreadsheet1.asp>
5. G. Holt, T. Campbell, E. G. Lightsey, "GPS Distributed Communications and Thruster Experiments on the University of Texas FASTRAC Mission", *Proceedings of the AMSAT-NA 22nd Space Symposium*, pages 235-250. See also, <http://fastrac.ae.utexas.edu/>

Manning the AMSAT table at the Smallsat Conference are L-R, Lee McLamb, KU4OS; Cliff Buttschardt, K7RR; and Nick Pugh, K5QXJ. (Photo credit: Al Zoller, N7UB.)

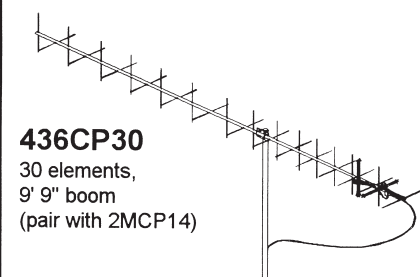


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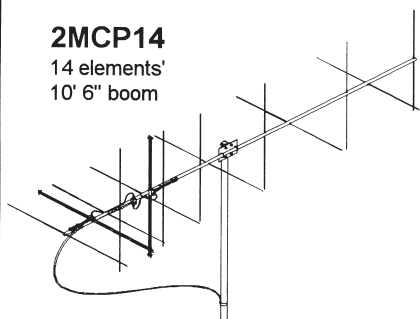
NEW!
Ultra-gain!



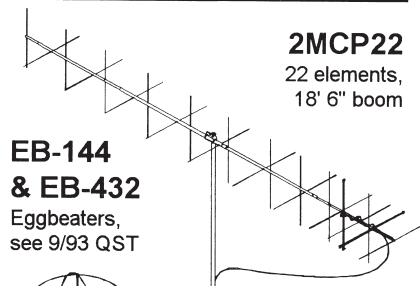
436CP42-U/G
42 elements,
18' 10" tapered boom
(pair with 2MCP22)



436CP30
30 elements,
9' 9" boom
(pair with 2MCP14)

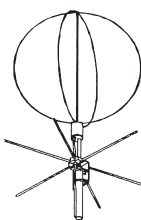


2MCP14
14 elements'
10' 6" boom



2MCP22
22 elements,
18' 6" boom

**EB-144
& EB-432**
Eggbeaters,
see 9/93 QST

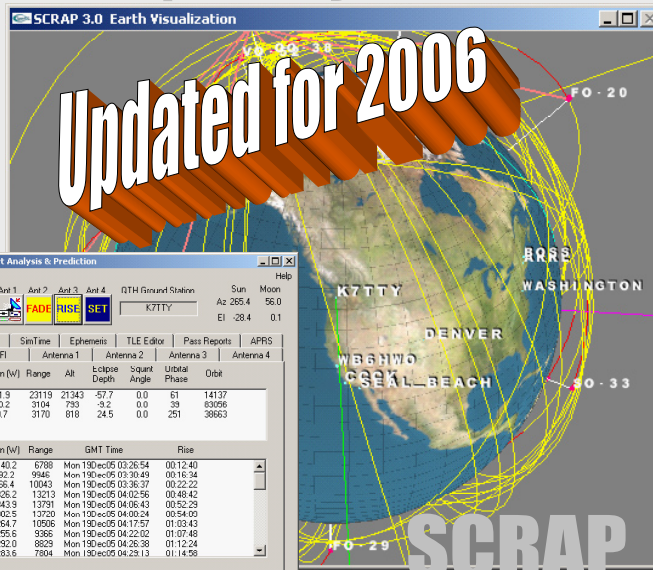


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Satellite Contact Report Analysis Prediction 3.0



SCRAP 3.0 Satellite Contact Report Analysis & Prediction

File

Coordinated Universal Time
Mon 19Dec05 03:14:14

Ant 1 Ant 2 Ant 3 Ant 4 QTH Ground Station
K7TTY K7TTY

Sun Moon
Az 285.4 56.0
El -28.4 0.1

Initialize	3D Earth View	Ground Station QTH	Sim Time	Ephemeris	TLE Editor	Pass Reports	APRS		
Multi Track	Auto	Conjunction	RPI	Antenna 1	Antenna 2	Antenna 3	Antenna 4		
Current Pass	Az	El	Lat	Lon (N)	Range	Alt	Eclipse Depth	Square Angle	Orbit
AD-10	179.5	40.9	8.3	121.9	23119	21343	-57.7	0.0	61
AD-16	337.1	1.6	69.0	150.2	3104	753	-9.2	0.0	39
GO-32	105.3	1.5	25.6	90.7	3170	818	-24.5	0.0	251
Predicted Pass	Az	El	Lat	Lon (N)	Range	GMT Time	Rise		
UD-11	200.4	-25.8	-11.4	140.2	6789	Mon 19Dec05 03:26:54	00:12:40		
AD-7	196.3	-38.3	-37.0	92.2	9946	Mon 19Dec05 03:30:49	00:16:34		
VO-32	137.5	-46.3	-36.3	66.4	10043	Mon 19Dec05 03:36:37	00:22:22		
SO-60	156.8	-60.7	-59.5	-325.2	13213	Mon 19Dec05 04:02:56	00:48:42		
FO-20	143.6	-74.4	-65.3	343.9	13791	Mon 19Dec05 04:06:43	00:52:29		
TO-32	0.0	-75.6	-23.3	202.5	13720	Mon 19Dec05 04:08:24	00:54:00		
AD-51	325.3	-47.9	23.5	264.7	10506	Mon 19Dec05 04:17:57	01:03:43		
TO-31	323.8	-38.8	35.8	255.6	9366	Mon 19Dec05 04:22:02	01:07:48		
DO-17	253.5	-36.5	51.3	-232.0	6829	Mon 19Dec05 04:26:38	01:12:24		
LO-19	300.7	-30.1	61.6	283.6	7804	Mon 19Dec05 04:29:13	01:14:58		

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Field Ops Update

by Gould Smith, WA4SXM, wa4sxm@amsat.org
Director Field Operations, AMSAT-NA

I am excited about a great year for AMSAT and great contributions from our volunteer Area Coordinator team.

SuitSat

The Area Coordinators (AC) contacted many local clubs to give them a document on SuitSat and attempted to convince the local clubs to contact local schools about a demonstration when SuitSat is launched. This is an outstanding opportunity for AMSAT members to influence a young person in space and satellites. This innovative project is geared toward young people with international messages recorded in multiple languages by their peers, real-time telemetry from the spacesuit and a SSTV image. Classes can receive a certificate upon successfully identifying the special message inside the downlinked messages. Kudos to the ARISS group, who conceived, developed and got this mission flown within a year.

2005 Field Ops Accomplishments

- Added 12 new Area Coordinators, 3 became inactive
- We represented AMSAT at 49 hamfests in 2005. This was an increase of 9 from 2004 and 22 from 2002.
- FOSS system became operational, through the efforts of EmilyClarke, N1DID. This is a great tool.
- Provided new and updated PowerPoint presentations to ACs through FOSS.
- Drew, KO4MA, implemented a membership campaign for satellite users that are not members.

2005 Field Operations Awards

These awards normally would have been presented at the large Annual Meeting/Symposium, but due to the circumstances, these exceptional volunteers were lauded to a smaller group at the Annual Meeting. I want to let everyone know about the extra efforts that these Area Coordinators performed for AMSAT this year.

Emily Clarke, N1DID (ex W0EEC)

Many thanks for your continued efforts in representing AMSAT during 2005 at four hamfests, assisting at Dayton all three days and giving five presentations, two of which you scheduled while on vacation. Your work on the Field Ops Support System (FOSS) has greatly enhanced communication among the Field Ops team. You certainly represent

the kind of spirit that all Area Coordinators should emulate.

Drew Glasbrenner, KO4MA

AMSAT once again owes you many thanks for your exceptional volunteer efforts. Your activities included organizing or participating in seven hamfests and many satellite demonstrations during the year. The demonstrations on multiple satellites on multiple days during Hamvention were exceedingly well received and served as an example of the best that AMSAT has to offer. Your volunteer spirit is a standard for others to strive for.

Keith Pugh, W5IU

Once again you proved to be a true road warrior for AMSAT leading six hamfests throughout the Southwest. Many thanks for your presentations, demonstrations and net contributions fostering interest in AMSAT.

Gerry Baker, VE4GTB

Many thanks for your efforts in representing AMSAT at multiple hamfests and giving three presentations in Manitoba and Arizona during 2005. Your international activities are much appreciated.

Stefan Wagener, VE4NSA

Although a new Area Coordinator your exceptional efforts to represent AMSAT are much appreciated. Your diverse contributions include three hamfests, two presentations, Field Day demonstrations, founding a Satellite Interest Group and initiating a CubeSat project.

Dee Interdonato, NB2F

Once again you have gone the extra mile to represent AMSAT in New Jersey, Pennsylvania and Dayton. Your hamfest presence, demonstrations and presentations were well received. Thank you for being a valuable member of the Field Ops team.

Kudos to the AO-51 Operations Group for creative, fun and challenging operational modes on the AO-51 satellite.

Looking for new Area Coordinators

I am always looking for enthusiastic AMSAT members that would like to give back to the organization. If you are interested in becoming an AMSAT Area Coordinator, please send me an email (wa4sxm@amsat.org), and I will send you additional information. I am especially

interested in people to manage and support AMSAT tables at local hamfests. These are the qualifications to become an AMSAT Area Coordinator:

- Maintain a current membership with Radio Amateur Satellite Corporation (AMSAT-NA)
- Have electronic mail capability through the Internet
- Have experience using the amateur satellites or ISS
- Be willing to work with individuals and organizations on a case-by-case basis
- Be willing to accept phone calls and e-mail from individuals at home
- Generate interest in future satellites like Eagle
- Be willing to have your name and address/home phone number listed in the Area Coordinators Listing and on the AMSAT Web site

2006 Goals

- Increase hamfest presence in 2006
- Talk up the Eagle satellite and assist with the fundraising
- Increase the activity level among the Area Coordinators
- Identify new items that can be sold at hamfests to generate revenue

Dayton 2006

We have already begun working on the AMSAT booth for the 2006 Dayton Hamvention. Mark these dates on your calendar Friday - Sun, May 19, 20 & 21. Come by the booth and visit with the AMSAT officers and Board members and talk amateur satellites with the volunteers. We will be having more forums this year, so plan on attending these interesting and informative talks. We will also have the Thursday night Beer and Pizza Bash and the delicious Friday night Banquet.

Regional Coordinators

We have a new group of volunteers that have taken on some extra work to personally reach out to the Area Coordinators in their region. These team members will help me improve the Field Ops presence at hamfests and clubs. They will be contacting all the ACs in their area to identify their activity level and how they plan on contributing in 2006. Local presence of AMSAT volunteers is critical



to our organization; please participate in hamfests, club presentations and local nets.

The Current Regional Coordinators are:

SE - Drew Glasbrenner, KO4MA (AL,FL,GA,KY,LA,MS,SC,TN)

SW - Keith Pugh, W5IU (AR,KS,NE,OK, TX,UT,NM,CO,WY,MO)

W, NW - Larry Brown, W7LB (AZ,CA, NV,ID,MT,ND,SD,OR,WA)

MW - Kevin Smith, N3HKQ (IL,IN,IA,MN,OH,MI,WI)

Canada - Stefan Wagener, VE4NSA (MB,BC,ON,QU,SK,AB,NB,NS,PE,NL, YK,NV,NW)

NE - Bill Polewarczyk, WA1DMV (NH,VT,ME,CT,MA,RI)

E - Dee Interdonato, NB2F (NJ,NY,MD, PA,NC,VA,WV,DE)

Other - Gould Smith, WA4SXM (AK,HI,VI,PR)

AC Spotlight

This time we put the spotlight on Drew Glasbrenner. Drew does so many things, so well for AMSAT that is difficult to list them all. Whether you are at a hamfest, satellite demonstration or the AMSAT-BB, you will hear or see Drew's name. Here is a little bit about Drew in his own words.

Drew Glasbrenner, KO4MA, AMSAT Area Coordinator – New Port Richey, FL

"My interest in radio began via shortwave listening in the 1980s and quickly grew into Amateur Radio in 1987 as I earned my Novice license. I upgraded to Technician class in 1988 and then Advanced in 1991. My interest remained mostly on HF DXing. I was introduced to satellite operations as many hams were at the time, by hearing N4ZC operating satellite on RS-12's 15m uplink. Soon after I was tracking satellites with a copy of *InstantTrack* on an outdated 8086 PC, and making many contacts on RS-12 with my HF station. As a poor college student I did not have the ability to assemble a full satellite station, but I did also listen to DO-17, AO-21 and RS-10, as well as make contacts via the Mir packet system. My interest waned in ham radio later on during college and for a while afterwards, and I was not very active in ham radio between 1994 and 1999. I purchased a used 2m all mode transceiver on a whim in 1999 and began working RS-12 again in mode T and A. I soon purchased a 2m/70cm mobile and

began working UO-14, SO-35, and AO-27. During a work trip to the upper Midwest I took along my new dual band mobile and a mag-mount whip and found that rare grids gave you at least a "20 db" advantage on satellite. I was hooked again. Since then I have expanded my operation to most of the modes and satellites available and have enjoyed making many contacts from many locations while portable and mobile. Some of the highlights of my operating include working DX on AO-40 mode U/S, operating portable as VP2EAG, FS/ and OZ/KO4MA, and visiting many rare grids in the continental US.

I volunteer (read as work for free!) for AMSAT in several capacities.

I suppose the most important thing I do for AMSAT is provide a presence at a number of hamfests every year. In the past few years I have represented AMSAT at Florida hamfests in Miami, Orlando, Tampa, Ft. Myers, Melbourne and Milton. I have also provided the satellite demonstrations for the Dayton hamfest for the last 2 years, proving that life does exist between HEOs. I try to concentrate on providing quality demonstrations of satellite operation that highlight how easy it is to work a satellite, and encourage interested amateurs to begin their satellite adventures by joining AMSAT.

Over the last year I have served as a member of the AO-51 Operations Group. The other members and myself take input submitted to the AO51-modes address and requests made to us at hamfests and on the air, and work with the command team to create a schedule of operations that serves the most users while maintaining a diverse selection of modes also serving the experimenters in our hobby.

I currently serve on the Web site technical content team. As a group we review the Web site for technical errors and try to provide peer review for the authors of Web site material.

Recently I have given presentations to radio clubs in Tampa, Clearwater and Orlando highlighting AO-51, HAMSAT VO-52 and P3E.

I provided guidance and loaner equipment for the KG4SB operation from Guantanamo Bay, Cuba, allowing many AMSAT members to add a new country to their DXCC satellite totals.

One of the newer things I have tried to do for AMSAT is provide occasional articles for the *Journal*, focusing on operating techniques and station design. I hope to expand this in the future.

I've auctioned artifacts from the construction of AO-40 to raise money for AMSAT-Eagle.

Outside of the world of AMSAT, I am a professional geologist working primarily in Florida dealing with sinkhole and development related issues. I occasionally travel for work, which provides a good opportunity to operate from new places. Besides Amateur Radio I'm also a cave diver, which gives me an almost unique perspective on my professional work. I've been married to a wonderful woman for soon to be 5 years, who is very understanding of my passion for all things that "go beep in space", and deep, dark holes in the aquifer. Many of you have met her at various hamfests around Florida. Merete is studying for her ham license and maybe someday you'll hear her on the air.

I'd like to encourage all satellite users to be members of AMSAT. We can all help support the satellite program financially or otherwise. As a reminder to members, you don't have to be an expert or have a title to promote AMSAT. All that is required is enthusiasm for satellite operation. Anyone can provide a presentation for your local club, set up a simple hamfest table or just Elmer other hams with their satellite stations. In the end everyone will benefit from our efforts.

73, Drew, KO4MA"

See cover photo of Drew in action. - Ed.

A big THANK YOU to the entire Field Ops team for volunteering your time and expertise to assist AMSAT and to help those interested in amateur satellite operations.



Please support AMSAT-NA.
Thanks!



Online Resources for the AMSAT Member

By Diane Bruce, VA3DB

AMSAT Area Coordinator

Introduction

Most Amateur Radio operators are aware of the World Wide Web, AMSAT's e-mail reflector and AMSAT's Web pages at <http://www.amsat.org>. These are an invaluable resource. But there are other online Internet resources that you may not be aware of. The main ones of particular interest to the AMSAT Amateur Radio operator in this article are Internet Relay Chat (IRC) and online audio streaming such as the icecast or shoutcast and Echolink/IRLP technologies.

The granddaddy of all instant messaging services is Internet Relay Chat or IRC. First invented in 1988 by Jarkko Oikarinen in Finland, it became well known to North Americans due to its use during the 1991 Gulf war. Software known as an "IRC client" is used to "chat" on various IRC networks that are available. EFnet, Undernet and Dalnet are the big three IRC networks, but there are many others. By connecting your

IRC client on your station computer to an IRC server on an IRC network you can join in online chats around the clock and around the world.

One such tiny IRC network which has been set up for those interested in all forms of satellite communication, including C-band and Amateur Radio Satellite, is the irc.dishnuts.net on with Amateur Radio satellite discussion happening on channel #amsat.

There are numerous IRC clients you can use to connect to an IRC:

- Windows - xchat and Mirc are very popular
- FreeBSD/linux and unix - xchat, ircII, BitchX, and epic are popular
- FireFox browser - can be used as an IRC client with the "Chatzilla" extension, making it a very simple choice for the beginner.

Here's How ...

For all IRC clients one must set up a "nickname" to use on the IRC network. Most Amateur Radio operators use their name and callsign on the Amateur Radio forums. Your IRC client will insist on a nickname being chosen before it will allow you to connect to an IRC server. The convention on the #amsat channel on irc.dishnuts.net is to use your first name and callsign. I would typically be "Diane-VA3DB", for example. However, anything up to 30 characters on this server is allowed.

Connect to an IRC server on the IRC network you wish to use

- The command is: /server irc.dishnuts.net
- Then join a channel using ... /join #amsat

As an example using FireFox, go to Tools on the menu see if you have "Chatzilla" already installed. If not, install the extension. See <https://addons.mozilla.org/extensions/moreinfo.php?id=16> for more information.

After you click on Chatzilla, it will come up with a window with a chosen nickname on the left and a blank "command" window on the right.

- Set your nickname to your name-callsign
- Type /server irc.dishnuts.net to connect to the IRC server

When your computer connects to the server you will see several status messages scroll by. When all the scrolling has stopped you can get on-line with other satellite operators with the /join #amsat command. On the FireFox Chatzilla window you will see a list of nicknames on the left side that have joined this channel. Once you are on the channel you can go ahead and type a "hello". The bunch up here is friendly and will not bite!

Every Tuesday night at 8:00 PM Central time, our very own Bruce Paige, KK5DO, shows up on irc.dishnuts.net on #amsat. Bruce has streaming audio of the AMSAT Houston net on the W0kie network via C-band as well as streaming mp3 audio to your computer. The Houston bunch takes check-ins from IRC for the net.

The Houston AMSAT net is also relayed on the Echolink network on the AMSAT conference (node 101377) with check-ins being relayed to Houston from there as well.

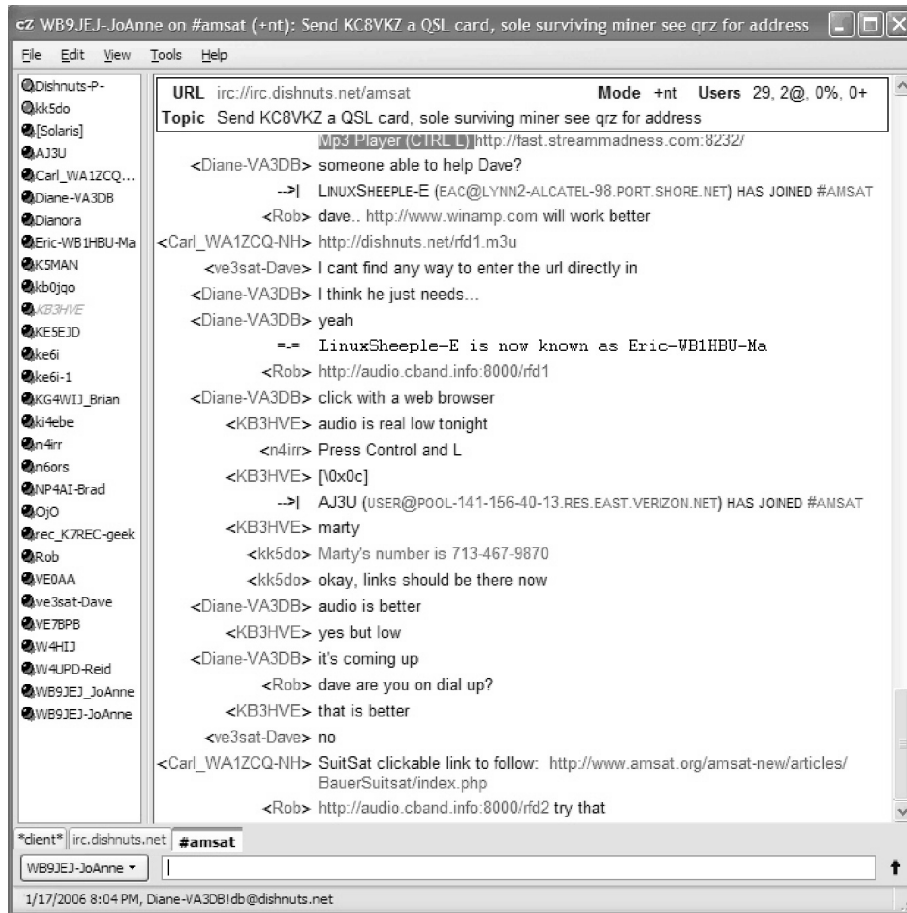


Figure 1
Screen shot of the FireFox Chatzilla window during the Houston AMSAT net.



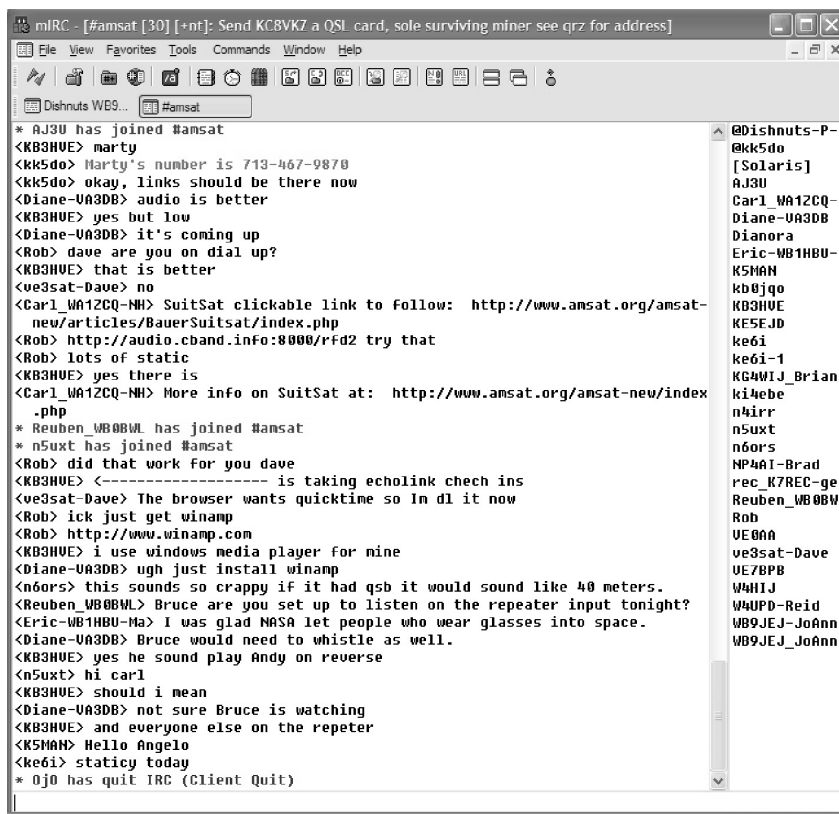


Figure 2
Screen shot of the mIRC window during the Houston AMSAT net.

Amateurs can listen to the streaming audio of this net by using a streaming mp3 player such as the Windows Media Player or WinAmp on Windows or XMMS on FreeBSD/linux/unix. The URLs you enter into the mp3 player to listen to the streaming audio from the net can be any of the following:

<http://dishnuts.net/rfd1.m3u>
<http://dishnuts.net/rfd2.m3u>
<http://fast.streammadness.com:8232>
<http://fast.streammadness.com:8230/rfd2>

Echolink was used at the AMSAT board meeting in October, 2005 to relay a live meeting to interested AMSAT members over the Internet. The AMSAT board plans to provide more of these on-line meetings in the future.

There are many more resources than the e-mail amsat-bb reflector and the Web pages available. I personally gained a lot of knowledge about setting up my first satellite station by talking to seasoned operators online on irc.dishnuts.net. It was very useful to me. (Thank you Roy, VE7BPB, and Mike, N4IRR!) ☺



Figure 3
Example window of the WinAmp Media Player used to listen to the MP3 audio stream of the Houston AMSAT net.

AMSAT-DC Meeting

NOTICE: NEW LOCATION!

AMSAT-DC MEETING AND SPACE SEMINAR

- WHO:** You! Ham radio operators, students, educators and the general public are invited.
- WHAT:** Talks, demos, tutorials and socializing about amateur satellites and balloon experiments in the mid-Atlantic area.
- WHEN:** Saturday, April 8, 2006, starting at 11:00 A.M. EDT.
- WHERE:** Historical Electronics Museum (HEM) at 1745 West Nursery Road, Linthicum, MD 21090 (near the BWI airport) www.hem-usa.org/
- WHY:** Fun, education, public service, cool stuff and more fun.
- HOW:** Talk-in on 146.760 MHz and check local APRS map.
- HOST:** Pat Kilroy, n8pk@amsat.org or Patrick.L.Kilroy@nasa.gov
- WEB:** www.patkilroy.com/amsat-dc/

Over the past few years, several ham radio friends that work satellites have set up a modest station for JOTA at the Troop 393 meeting location on, Merritt Island, Florida. We have always had fun, but this year was especially noteworthy for the reason I will describe later in this article.

Some months prior to JOTA the special event call sign, W4J, was requested and assigned by the ARRL. Lee, KU4OS, ran the passes for the usual suspects, ISS, SO-50, AO-7, FO-29, AO-51 and VO-52. This year the passes were conveniently clustered between 0830 and 1230 local, Eastern Daylight time.



Homebrew HF dipole supports built by Troop 393. (Credit: Roger, WB9NOE)

About 0800 on 15 October, KU4OS, and I arrived at the Troop 393 headquarters and began setting up a portable satellite station consisting of a dual-band hand held, a small UHF Yagi antenna and the two meter mag-mount vertical on Lee's car. Don, AG4FC, arrived later with his dual-band handheld and portable V/U Arrow antenna. Al, N4TME, then came with his HF transceiver and two homebrew loop antennas, one for 80 meters, the other for 40 meters. Our troop contact



Scouts gather around the car of Lee, KU4OS, for an ARISS contact. (Credit: Roger, WB9NOE)

Roger, WB9NOE, had the scouts construct two lashed together tripods to support an HF trap dipole. Older scouts mentored the younger ones in the proper technique of lashing three poles together to form a stable tripod support. We also provided a basic introduction to amateur satellites and how we were going to attempt to make contacts.

While waiting for the first of the satellite passes the HF radios were put on the air and tuned to the JOTA frequencies, primarily on 20 meters. Scouts gathered around the rigs and contacts began to be made. The scouts were very interested in talking to other scouts via ham radio. WB9NOE had a prefix map setup on an easel that the scouts could use to locate the particular area of the country where the contact was located. This was especially helpful for the Canadian hams that were heard and contacted. We also had a grid square map showing how the US was divided up into squares for identification.

The first satellite contact of the day was made with the International Space Station, NA1SS on the 1320Z pass. Not surprisingly there was a lot of traffic into the ISS making it a challenge to get through, but near the end of the pass we succeeded. Immediately after the pass almost every scout whipped out a cell phone because they just had to tell someone about actually talking with the astronauts. SO-50 provided the next contact with NX2X in New Jersey. The 1423Z pass for AO-51 turned out to be the most productive of the day with 7 contacts being made. A number of the scouts were able to talk with other operators and exchange information, such as grid square and weather. The scouts were also quite impressed that AO-51 command station operator Mike Kingery, KE4AZN, took the time to have a nice chat with them. Having AO-51 in dual voice mode really enabled a lot more contacts to be made.

The highlight of the event came on the next ISS pass at 1455Z. This pass was unique for our location on the East coast of Central Florida in that ISS set at 162 degrees to our southeast, which meant we were among the last US locations within the Station's footprint. We waited until the traffic thinned out, made a call, and the ISS Commander, William McArthur, came back acknowledging our call with a solid copy. After a quick exchange the



Scouts making HF contacts between satellite passes. (Credit: Roger, WB9NOE)

Commander again called "CQ JOTA" but apparently no other calls were made to ISS and Commander McArthur then called back to our Station and carried on a conversation with one of the scouts, Colin, for several minutes, until the ISS was out of range. As the conversation progressed, all of the scouts and adults gathered around to listen as Commander McArthur described the earth features the ISS was flying over. Needless to say everyone was very excited to hear an actual conversation with the ISS rather than just the usual quick station acknowledgement. Colin was so excited that he immediately called his parents. Even those of us who have been working satellites for some time were pumped since none of us have had an extended conversation with anyone on ISS beyond the usual exchange. As a result of that contact we have remained not only excited but have a renewed sense of purpose and dedication to extend our satellite communications capability into other modes and explore other station possibilities relating to amateur space communications.

JOTA provides a rare, once a year opportunity for hams to interact with young people, to share the joy of ham radio and at the same time, provides a wonderful educational forum. Our small group has thoroughly enjoyed the experiences we have had over the years participating in JOTA, not to mention getting a really cool commemorative patch. Hopefully, we have been able to convey our enthusiasm for the hobby and impart to the scouts and adults some of the technical aspects of Amateur Radio and satellite communications.

All this with a few printouts, a compass, handhelds and portable antennas!

Thanks to Lee, KU4OS, for review and comments for this article. ☺

2006 AMSAT Space Symposium and General Meeting

by Emily Clarke, N1DID, n1did@amsat.org

AMSAT is excited to announce the 2006 AMSAT Space Symposium and Annual meeting will be held in October at the Crowne Plaza Hotel - San Francisco Mid-Peninsula in Foster City, California. The Symposium will again be a joint meeting with the ARISS International Delegates and will also include the IARU Satellite Advisory Panel annual meeting and a meeting of AMSAT International Delegates.

Mark your calendar - 5 through 11 October 2006

The Crowne Plaza is conveniently located close to San Francisco International Airport, which is a major point of entry for direct flights daily from Europe, Asia and Oceania and is equidistant between the cities of San Francisco, San Jose and Oakland.

daily. If you are worried about the length of your trip, flying from Europe to San Francisco is direct and will only add one to two hours compared to flying into the east coast. If you are flying direct, be it from Europe, Asia, or Oceania, your "port of entry" will be San Francisco provided you book a direct flight.

The Crowne Plaza will provide free shuttle transportation to and from San Francisco International to the hotel. Cabs, limos and shuttles are also available for a fee. If you are arriving at an airport other than SFO you should consider one of the shuttle services or public transportation. A complete list of these services are listed on the AMSAT Web site in the 2006 Symposium section.

You can generally get from any airport in the

the shoreline and through a nearby parks and nature preserves.

If you prefer more of an urban environment, San Francisco is only a 30 minute bus or train ride. San Francisco is a world class city with unique activities, shopping, dining and history. The Symposium committee will be happy to arrange activities for spouses and children. Available tours include a city tour to see Fisherman's Wharf, Alcatraz, the Cannery and Ghirardelli Square - home of the world renowned Ghirardelli Chocolate Factory.

The bay area is also home to the San Francisco 49ers, Oakland Raiders, Stanford Cardinals and UC Berkeley Bears, all of which will be playing football during the Symposium. The Golden State Warriors



The host for the 2006 Symposium is the Project OSCAR radio club, which is proud to welcome AMSAT members back to the beginning roots of the amateur satellite service.

Arriving by Plane

The San Francisco bay area is served by three major airports (San Francisco (SFO), Oakland and San Jose). All have modern facilities and in the case of San Francisco completely renovated terminals and customs facilities. Direct flights from most international cities arrive and depart

bay area to any location in the bay area by public transportation. It will take more time, but it is convenient and inexpensive.

San Francisco Bay Area Information

The time of year is perfect to visit the Bay and surrounding areas with average temperatures averaging 75F (23C) and the likelihood of rain close to nil. So it is the perfect time to plan a trip to the wine country, beaches, the mountains and valleys. We are sure you will not be disappointed. Even if you want to stick nearby, the hotel is located near several paths and trails that wind along

and San Jose Sharks should also be playing basketball exhibition games. We've also put in a special request for the Giants and A's to make the playoffs! If sports are your passion, you will be passionate about Bay Area sports.

Online Registration! Easy ...

We are sure you will enjoy the Symposium and the vacation of a lifetime! This year you can register for the Symposium online, make hotel reservations and arrange for upgrades online as well! Online registration will begin approximately March 15, 2006. ☎



Canary Jails Make Great Antennas!

A New Tool to Help Work the Satellites – The CJU Antenna

Juan Antonio Fernández Montaña, EA4CYQ, ea4cyq@amsat.org

Pedro Pérez Álvarez-Cienfuegos, EB4DKA, eb4dka@amsat.org

People tend to stick to stereotypes because they feel comfortable and reassured, so they do not waste time making mistakes to reach a target. But perhaps one of the most important characteristics of hams is their desire to improve their station, accessories and skills to work more efficiently.

Experience has demonstrated to us that if we need to be heard by a satellite, we do not need very complex antennas. Except for colinear antennas which have a very low angle of radiation, nearly all types of antennas could work fine with satellites. But a $\frac{1}{4}$ wave antenna stands out in terms of uplink performance and simplicity until about 45° of elevation. To overcome polarization losses we can increase the power output a bit. However, to receive weak signals from a satellite is a bit more difficult, especially if we want to work from our comfortable armchair in the shack. We need expensive equipment, beam antennas with polarization change capability or circular polarization and a low loss feed line plus computers to aim the whole antenna structure toward the correct azimuth and elevation.

But in contrast to a complex fixed station, the fact is that with a small hand-held antenna we can obtain the same outcome.

That's absolutely true. The key is that we can aim the antenna by hand to the exact Az-El position and rotate it to get the needed polarization. In addition, the short feed line from antenna to receiver reduces line losses to a minimum. Some people think that it is not possible to operate like this. If you think so you should try the antenna described here yourself.

As described above we can come to the conclusion that a simple and effective satellite station, in terms of an antenna system, could consist of a $\frac{1}{4}$ wave whip on the car roof to uplink and a hand-held antenna through the window of the car to receive the downlink. Since a dual band full-duplex transceiver is a bit expensive, we can work with slightly higher power out using a monoband mobile and a whip antenna on the uplink and an HT with a gain antenna attached to it to receive the downlink.

Some months ago we were surprised to find an article by our friend Pedro, EB4DKA, in the September/October 2005 issue of *The AMSAT Journal* telling how to work LEO satellites with the equipment that was described. But he works SSB satellites with a TM255 and $\frac{1}{4}$ wave antenna for the uplink and a TH-F6 with a whip antenna for the downlink regularly.

The following question can be asked: Is this a mobile or portable station? Or perhaps in the same way we name the 'mode' V/U, we should name these working conditions mobile/portable if we stick to the pattern uplink/downlink. I don't know the correct definition; the only thing we know is that this kind of station can work satellites easily, even on SSB.

But as discussed above, Pedro does not have any problem with the uplink. I have received his signals many times and they are strong like a fixed station. If stronger signals are needed he can always increase the power output. So to improve Pedro's station focus should be placed on the UHF downlink since the VHF signals are strong enough. We have browsed the Internet searching for small size high gain UHF antennas and tested nearly all of the HT antennas in the market. But we have not found a whip antenna which lets us work satellites comfortably. So if we want to improve downlink reception, we have to use a beam antenna like an Arrow or an IOio (see the last *Journal* issue – Ed.). But, then again, we only have two hands to control two transceivers and an antenna, so we still need another hand!

Then we began searching for a high gain UHF beam antenna small enough to be plugged in directly to an HT. We did not find an antenna of that type available. Then we thought why not to build one?! We needed a small UHF directional antenna. Looking around we have some well-known types, Arrow and IOio. The Arrow is 1.2 meters long although we could reduce the number of elements. The IOio in this part of the UHF band only is 0.2 meters long and its gain is sufficient according to our earlier experience. You can also see K5OE's Web site to build and perhaps revise his TPMII designs.

Keeping this idea in mind, I needed a 20 centimeter long boom. It could be made of plastic or PVC, but it had to be 10 millimeters inside diameter because that is the diameter of a BNC connector so we could attach the antenna directly to it. I was talking about it with my father, EA4ABV, who has another hobby apart from the radio. He raises canaries. I saw something that gave me an idea. Canary cages (also known to me as canary jails) had a little plastic stick inside

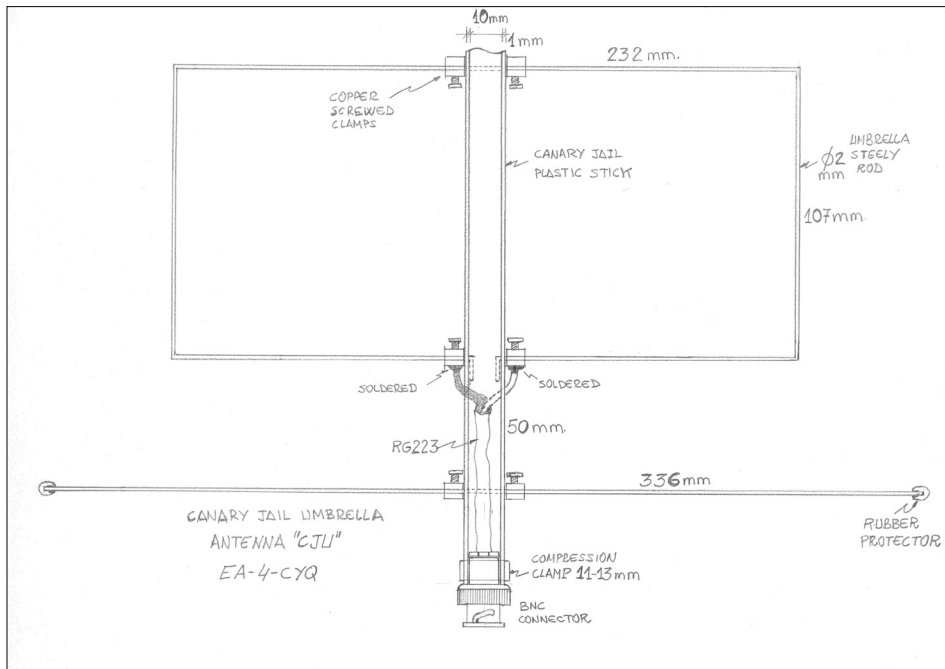


Figure 1
Construction details of the CJU antenna.



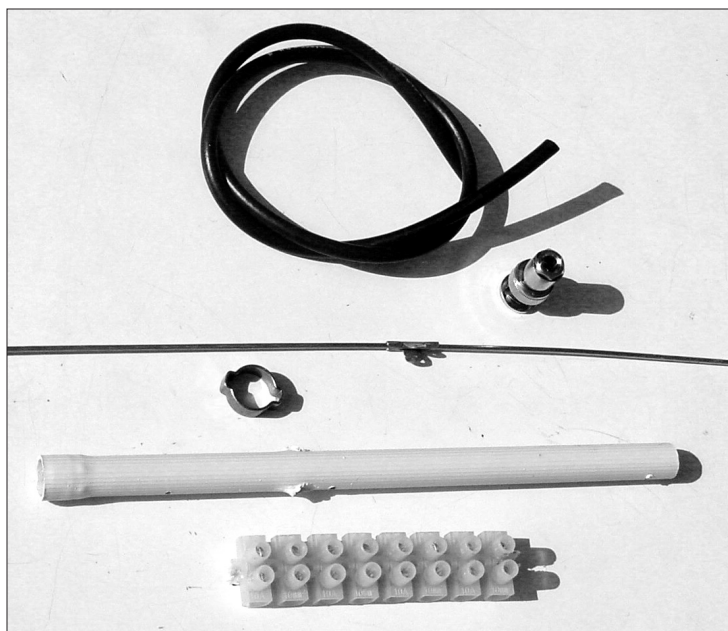


Figure 2
Parts needed to build the CJU antenna.

which the canaries perch on. I used the inner diameter of the perch and it was perfect.

Now I had to search for a thick steel wire to build the antenna elements. On the way home from my father's house I saw a broken umbrella tossed in a trash can. The

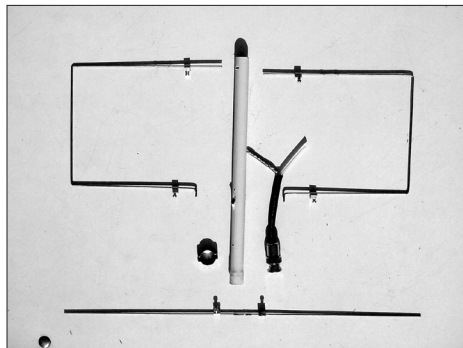


Figure 3
Antenna parts ready for assembly.

rods were perfect. It was a lucky morning walk. To connect the driven element to

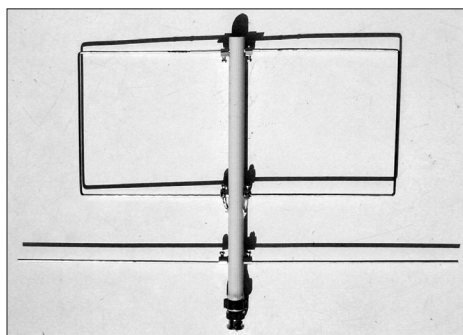


Figure 4
The nearly completed antenna.

the BNC connector I used a piece of RG223. Two or three evenings later I had built the prototype and it was Pedro's turn to test it because Pedro is the 'expert' at working in portable conditions.

When I showed the antenna to Pedro and told him that it was made with a "canary jail stick" and a broken umbrella, he laughed for a while and quickly named it the "CJU" (Canary

Jail Umbrella). But we both had the same question in mind – will it work?

Pedro has been testing the "CJU" for several weeks now with FM and SSB V/U satellites and has obtained amazing results. Only the Arrow performs as well. In this antenna two decisive factors work together - its high dB/size relationship and its low loss feed line. The antenna works as well as if it has a preamplifier. The signals received from FO-29 using the TH-F6 were up to 5 and the antenna was able to receive SO-50 signals from AOS to LOS with no problem at all.

This outcome is surprisingly good. You should try this antenna yourself. You can find the construction details of this small amazing antenna in the corner of Pedro's Web site at: <http://www.eb4dka.tk>. Our e-mail addresses are above.

Almost all hams have a mobile

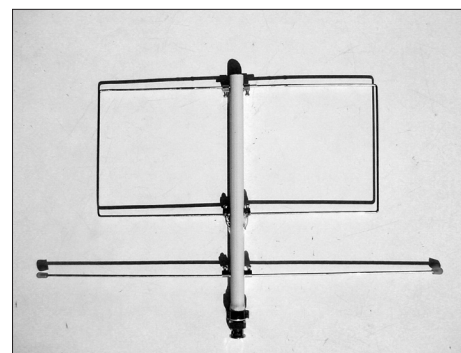


Figure 4
Antenna assembled with rubber element protectors on the ends of the reflector.

transceiver in their cars and an HT. Why do they not work satellites? Perhaps it's because they do not have a "CJU". Now days some of us have an all-mode transceiver in our car (IC-706MKIIG, FT-857/897) and an all-mode HT (like a TH-F6), so we can work all kinds of voice LEO satellites. We are looking forward to testing the 'CJU' with the next HEO satellite which will surely work in mode U/V.

All of us can contribute to AMSAT. Perhaps one of the best ways is to show easy ways to work the satellites and publicize our experiences. If more of us work together we will accomplish more goals. In this way I will try sending a step by step article to QST and URE (Unión de Radioaficionados Españoles) to attract more people to this amazing world of AMSAT. 🌐

Editor's Note: Although lightweight, the CJU antenna can put considerable strain on the HT's antenna connector.



Figure 3
The CJU antenna attached to an HT.

Satellite Contact Report Analysis & Prediction (SCRAP) Version 3

William H. Bytheway, K7TTY, k7tty@arrl.net

What is SCRAP?

Satellite Contact Report Analysis & Prediction (SCRAP) is a tracking, report, analysis, prediction and 3-D real time display program. SCRAP tracks and predicts passes of satellites based on the geographical location of the ground station, the current date and time and Keplerian orbital data

the program performs millions of floating-point calculations every second. Therefore, the minimum recommended platform is Windows 98 or better running on a Pentium Processor with a clock speed of 500 MHz or greater, 256 Mbytes RAM and a graphics accelerator card with OpenGL support. Of course it helps to have at least 1024x768 resolution.

For example, test results on a Windows 98 500 MHz Pentium show that it takes about 5 seconds to calculate 200 satellite positions and display the results. If your processor does not meet the minimum recommended horsepower it is suggested you should keep the maximum number of satellites to a

minimum. This can be done at run time via a command-line entry.

Display and Control

The display is organized into tabbed panels as shown in the picture below, thus allowing the user to control SCRAP's features. This screen shot shows the Multi-Track display option.

The display is organized into panels as shown in the picture at the top of the next page, thus allowing the user to control SCRAP's features. In summary these functions are listed in the table below:

Initialize	Allows the user to load in the various TLE files and to download new TLE files from the Internet.
Earth View	Selection of viewpoint to include country, satellite, QTH, etc. and to select the Earth Orthographic projection overlay map and display options.
Target QTH	Select the QTH to be used for pass predictions and reports.
Simulation Time	Define a simulation and step time other than current UST time. Useful for stepping forward or backward in time for testing.
Ephemeris	Set the SGP propagation model and view the position and velocity of satellites.
TLE Editor and Viewer	View and edit the decoded TLE parameter in classic Orbital Elements.
Pass Report Generator	Produce predicted orbit pass reports, visible passes and solar illuminations.
APRS Plotting from Internet	Download APRS stations via Internet. Locations can be used for prediction and display.
Multi Track	Display current and upcoming passes in real time.
Antenna	Az/EI rotor control for up to four antennas.
Conjunctions	Calculate conjunctions between satellites.
RFI	Calculate radio frequency interference for satellites in contact.
Astro-Dynamics	Calculate position of the planets and look angles from your home QTH.

for the satellites of interest to the ground station. SCRAP was released by AMSAT over two years ago as a joint agreement with the author.

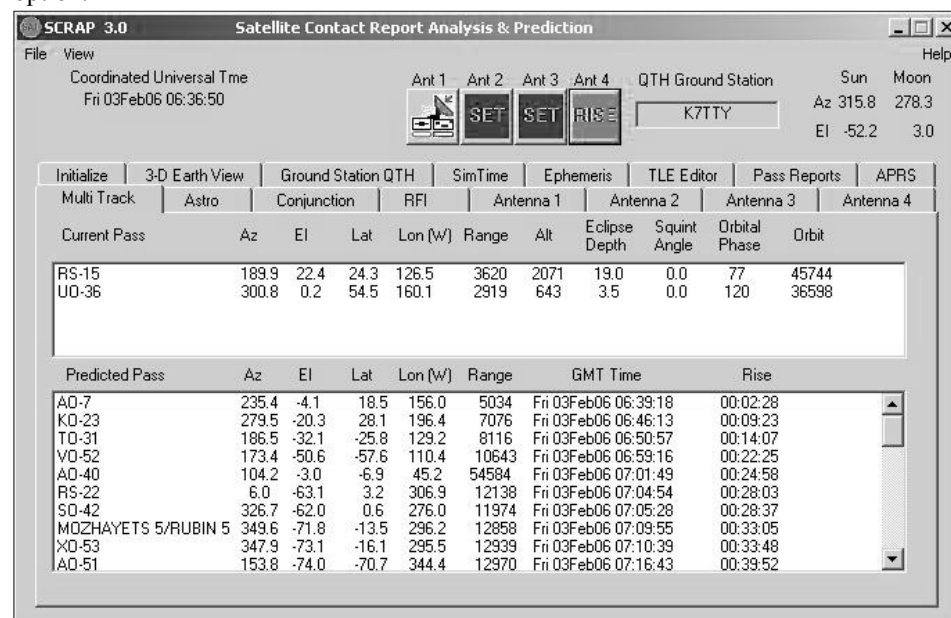
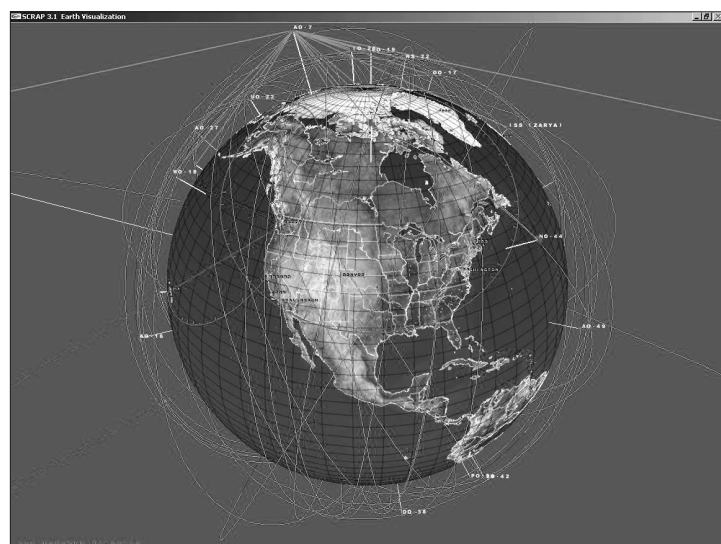
Since its original release, the project has added several new features to include radio frequency interference (RFI) and satellite conjunction analysis. A conjunction is useful if you wish to use one satellite to communicate with another satellite as a relay.

SCRAP is similar to Analytic Graphics STK, Aerospace SOAP, Predict and InstantTrack software. This software was developed using Microsoft Visual C++, OpenGL and a modified version of Glut DLL.

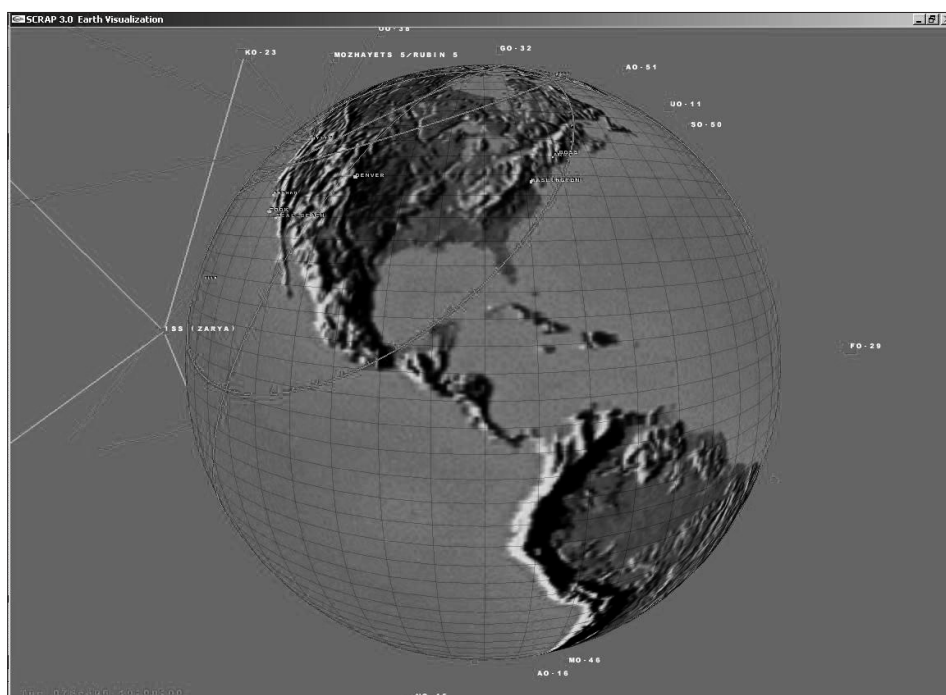
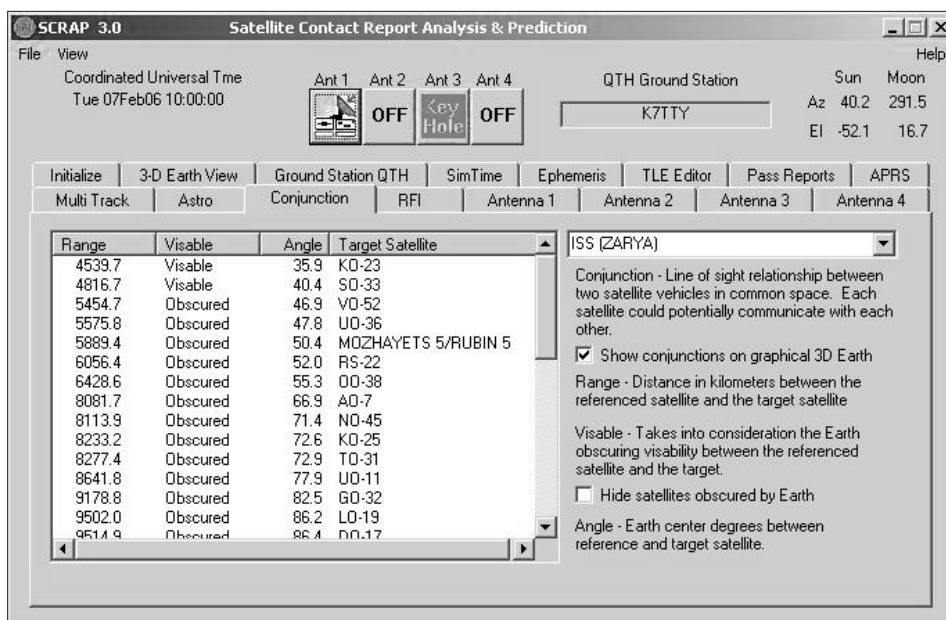
Scrap is based on NORAD's Spacetrack SGP propagation algorithms and John Magliacane's PREDICT. As such, SCRAP was developed under the GNU General Public License (GPL) and the source code is also available from AMSAT on the distribution CD-ROM (<http://www.amsat-na.com/category.php?c=Software>).

Supported Computer Platforms

SCRAP is not for the underpowered computer. To propagate ephemeris for each of the satellites it displays and reports on,



Multi-track display.



Tabular (above top) and graphical (directly above) conjunction displays.

Conjunction (Satellite-to-Satellite)

Conjunction between satellites occurs when two satellites can be seen by each other. SCRAP allows the user to select a single satellite of interest and calculate conjunctions taking into consideration the obscuration of the Earth. A check box is provided to graph a connecting line on the 3-D Earth window.

Conjunctions can also be viewed on the 3-D Earth view by checking the “Show

Conjunctions” check box. In this example, my station K7TTY, cannot see ISS, but KO-23 is visible from ISS and K7TTY. The range between ISS and the relays is about 4540 km. K7TTY can see KO-23 with an 88 degree elevation pass at a range of 1318 km. Contact may be possible using Mode JD 9600 bps FSK.

Radio Frequency Interference (RFI)

Interference is possible if two satellites as viewed from the ground station have a low

delta angle between them. Depending on the antenna and path losses, it could be possible that two satellites could be communicated with at the same time. A display is provided that shows the angle in degrees between the referenced satellite and target satellite. If any two satellites are using the same uplink or downlink frequency, then RFI is possible.

Control of Up to 4 Antennas

This antenna feature allows the user to control an azimuth-elevation rotor for real-time antenna pointing. Elevation angle control is suppressed until the angle rises above zero. The QTH is selected from the “Ground Station QTH” panel and once you start control you cannot change the QTH until you stop the action (just a little protective control). The precision function allows you to update the rotor with data that has less than one-degree accuracy. Data is sent to the rotor once per second. The icon will change from set (no contact), to rise, to the antenna symbol, to fade and finally loss of signal. The icon is also displayed in the upper section. The Maximum Azimuth, Elevation Delta, and Azimuth Delta can be set from the initialization file and the numbers are set at runtime. See the panel on the next page.

New Feature: Separate Display Windows

In the past, you were only able to view one tabbed window at a time, similar to many other satellite tracking programs. A new feature has been added that allows you to separate the selected windows from the main display. In the second picture on page 28 you can find the following windows:

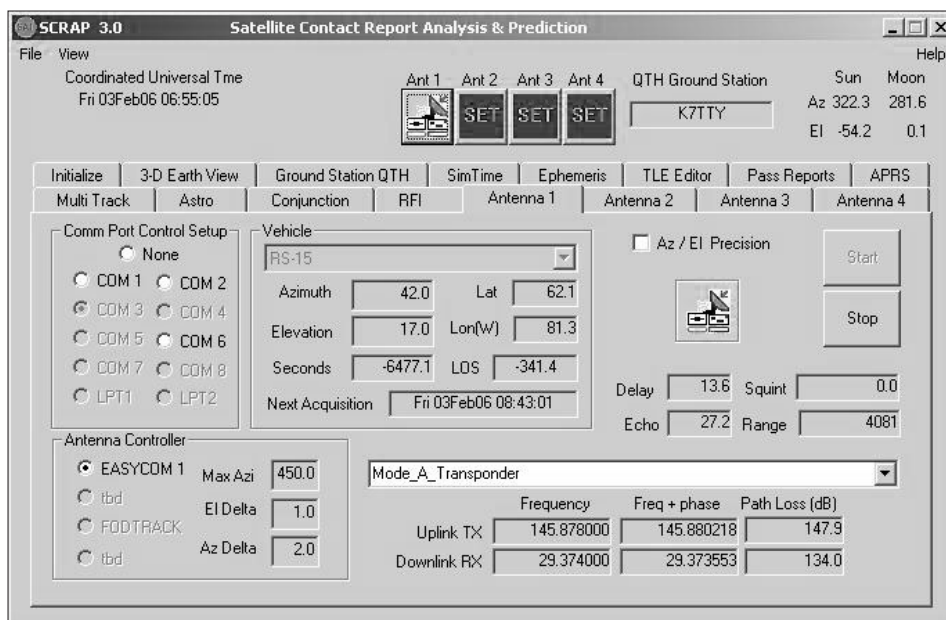
- Astro-Dynamics – Look angles to the nine planets
- TLE Editor – View and edit each of the two line orbital elements
- Multi-Track Viewer – View current and upcoming satellite passes
- Satellite Conjunction – Distances between two satellites
- Radio Frequency Interference – Possibility of RFI during any contact

Obtaining the Software

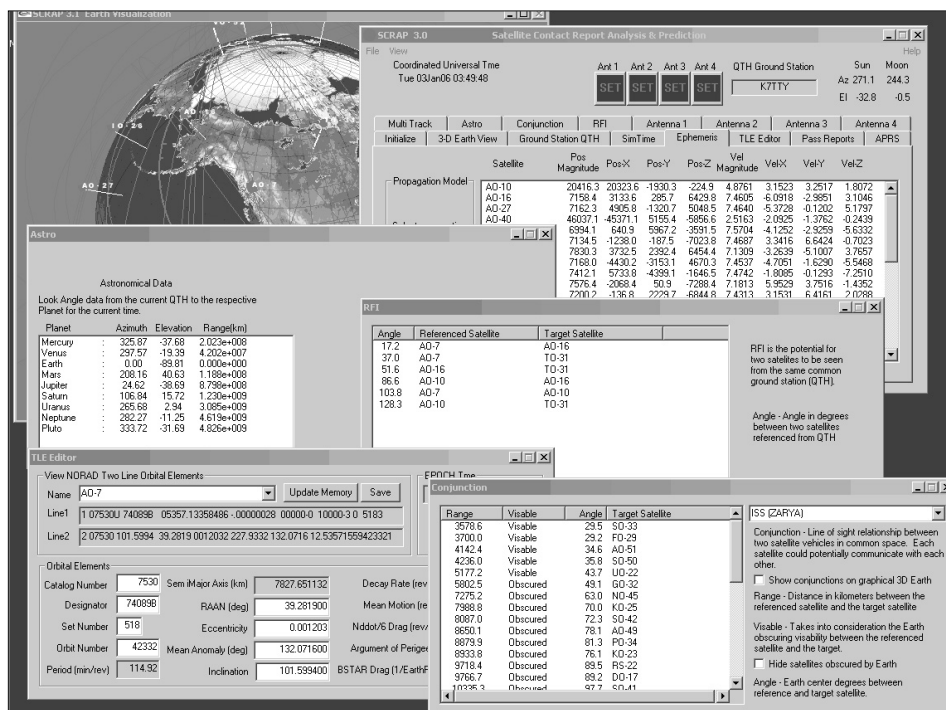
SCRAP is distributed by AMSAT-NA. See the SCRAP ad on page 17 of this issue for more information. Contact the AMSAT office to order. The price is \$50 for members and \$60 for non-members.

continued on the next page ...





Antenna control display (above).



A new SCRAP feature - multiple window views.

About the Author

William Bytheway, K7TTY, has been licensed since 1969 and has 30 years of experience providing software and systems engineering development support to the aerospace and defense industry.

Programming language capability include C/C++, HTML, JAVA and PASCAL with some experience in BASIC and FORTRAN. Included are dialog-based WIN32 applications using MS Visual C++

6.0, Borland PASCAL 7.0 and C++ 4.52 IDE. Bill has performed extensive work with RS-232 and TCP/IP protocols on DEC-VMS, UNIX and DOS/WIN32 systems.

Aside from developing SCRAP, K7TTY also has an interest in antique radio Teletype machines and software development to support integrating computers and mechanical teletypes.

Additional Web site Information and Support

Since its original release, the author, from his home Web site at the following URL, has provided SCRAP support as well as free updates and fixes to the product: <http://207-207-72-42.ip.theriver.com/>

For more information about RTTY please visit the following site: <http://www.rtty.com/>

For information on how to obtain the software on CD-ROM visit: <http://www.amsat.org> or call the AMSAT office.

Editor's Note: SCRAP has very colorful display panels that easily show satellite orbits and a wide variety of other information. Grayscale graphics as printed in the Journal don't show the full extent of SCRAP's capability. Why not try a copy of SCRAP and see just how great it is. You'll support AMSAT too!

SuitSat from NASA

ISS012-E-15666 (24 Jan. 2006) --- An old Russian Orlan spacesuit is photographed in the Unity node of the International Space Station, which was released by hand from the space station during a spacewalk Feb. 3, 2006. Outfitted with a special radio transmitter and other gear, the spacesuit comprises a Russian experiment called SuitSat. It will fly free from the station as a satellite in orbit for several weeks of scientific research and radio tracking, including communications by Amateur Radio operators. Eventually, it will enter the atmosphere and be destroyed.

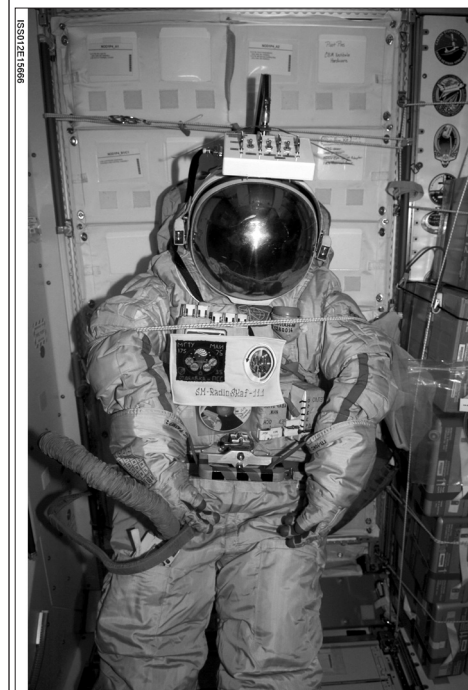


photo and text courtesy of NASA



Eagle RF meeting November 26, 2005

During the 2005 Thanksgiving holiday weekend, AMSAT President Rick Hambly, W2GPS, VP of Engineering, Dr. Bob McGwier, N4HY and Dr. Al Katz, K2UYH, President of Lintech and professor of electrical engineering at the College of New Jersey, hosted a meeting for several radio amateurs and a student to tackle some of the RF parts of AMSAT-NA's Eagle project.

The attendees included:

- Dr. Tom Clark, K3IO (ex W3IWI), AMSAT-NA chief scientist
- Paul Drexler, W2PED, Microwave R.F. designer
- Matt Ettus, N2MJI, Gnu Radio project co-leader and designer of the USRP (universal software radio peripheral)
- Dr. Marc Franco, N2UO, Lintech, Inc. engineer
- Steve Hendricksen, EE student at the College of New Jersey
- Jan King, W3GEY/VK4GEY, one of AMSAT's founders, former VP Engineering, and former board member
- Paul Wade, W1GHZ, well known Microwave engineer whose Web based microwave handbook is read the world over.
- Marc Zaharchuk, WA3CRM, Lockheed Space RF Engineer

Rick, W2GPS, got the meeting started with an overview of the project, our organization and the goals of Eagle. Bob, N4HY, then discussed the overall RF requirements for the spacecraft, including the use of SDX

as the primary linear transponder with the need to plan for an all-analog backup and for command receivers. Tom, K3IO, then gave a detailed analysis of the C-C Rider phased array of patches. Matt, N2MJI, talked about Gnu Radio, the Universal Software Radio Peripheral, and his proposal for the CC Rider ground station, which has been generously funded by Phil Karn, KA9Q.

As a result of the weekend Marc, N2UO, who has years of RF experience including amplifiers in space, has signed up to do the envelope restoration (HELAPS) transmitters. John Stephensen, KD6OZH, has signed up to lead the receiver development and is working first on the 70 cm receiver. Paul, W1GHZ, has agreed to design a critical component for CC Rider, the bandpass filter which will be needed to allow the transmitter and receiver to share antennas. Finally, Al Katz, K2UYH, President of Lintech, Inc. has graciously offered to host an RF facility for the AMSAT Eagle project at Lintech in Hamilton, NJ. This provides the Eagle RF team with access to a large collection of lab/test equipment and a first class clean room facility for the development, construction and testing of Eagle's RF modules.

The RF group is not the only part of the Eagle Team making progress. The mechanical and structural group is also hard at work on the modules and space frame for Eagle. See the Eagle article on page 4 of this issue of the Journal.

The Eagle RF team met at K2UYH's LINTECH lab on 11/26 to discuss RF ideas for Eagle. Here you see (left to right):



Al Katz, K2UYH; Matt Ettus, N2MJI; Rick Hambly, W2GPS; Marc Franco, N2UO; Steve Hendricksen, Student at TCNJ; Bob McGwier, N4HY; Jan King, W3GEY/VK4GEY; Paul Wade, W1GHZ; Paul Drexler, W2PED; Tom Clark, K3IO (ex W3IWI). Missing from the picture, but attending the meeting - Marc Zaharchuk, WA3CRM.

AMSAT at School

Pat Kilroy, N8PK, AMSAT Area Coordinator for Maryland-DC and David Bern, W2LNX, gave a presentation on amateur satellites to Parkland Magnet Middle School for Aerospace Technology during the school's "Satellite Night" on January 25, 2006 at Rockville, MD. Pat said "Our demos for AMSAT and NASA were very well received. The count was 62 people for our 35-minute presentation plus 15-minute follow-up chats." See the school's Web site at <http://www.parklandmagnet.com> for pictures. Also see: <http://www.patkilroy.com/amsat-dc/> for additional information on the presentation.



AMSAT member David Bern, W2LNX, describes directional antennas to students and parents at Parkland's "Satellite Night" in Rockville, Maryland on Tuesday, January 25, 2006.



NASA engineer and AMSAT Area Coordinator Pat Kilroy, N8PK, at the Parkland Magnet Middle School for Aerospace Technology, prepares a lesson on receiving SuitSat signals from space.



Another view of David as he describes directional antennas to students and parents at Parkland Magnet School.

Changes to Frequency Coordination Requests

Hans van de Groenendaal, ZS6AKV, hans@intekom.co.za

IARU Satellite Advisor

The Satellite Frequency Advisory Panel working with me has updated the Satellite Frequency Coordination request form to correct some shortcomings that have become apparent during the past few years.

Some requesters send the minimum of information, while others send a "complete book". Dealing with the files that are a few megabytes large can be problematic bearing in mind that the panel membership extends from the US to the UK, to South Africa and Australia. Often copies of the coordination request form and other information has to be shared with AMSAT groups and National Amateur Radio Society, further complicating the process. We therefore request that only the request form be returned to us and if there is any additional information that this be placed on a Web site or ftp server for the panel members to download as required.

The revised request form is available from www.iaru.org/satellite. It is important to read the instructions and to separate the instructions from the form before submitting it. While visiting the Web site also look at some of the other documents of interest to satellite builders and users.

Always download a fresh request for coordination form for every application as the forms are dynamic and are updated from time to time.

To ensure a certain acknowledgement receipt of the request, it is important to e-mail the form to satcoord@iaru.org with and a copy to hans@intekom.co.za. Satcoord is a re-mailer that delivers copies to the panel members. Adding the additional address will help to ensure that no files disappear into cyberspace.

The Advisory Panel also maintains a frequency coordination status report, which can be accessed from the IARU Web site www.iaru.org/satellites. There are some other interesting documents available from the Web on this site, including a file called "Amateur Satellites" giving a detailed description of what makes a satellite an Amateur Satellite and other regulatory issues.

Satellite frequency coordination is not a simple process. The regulatory environment is not the same in every country. What is considered allowable on amateur frequencies in one country is not necessarily acceptable in another country. The panel will therefore enlist the assistance of the local Amateur Radio society or AMSAT group to deal with regulatory issues.

Satellites by Educational Institutions

With the arrival of Cubesats, many universities have discovered that satellites provide ideal teaching opportunities, particularly in the postgraduate environment.

We have therefore seen a proliferation of new Cubesats, and those projects want to operate on amateur frequencies.

I consulted with the IARU Administrative Council for guidance. The Administrative Council responded as follows: *"the Council understands that it is sometimes difficult to determine whether a particular satellite that is intended to operate in the amateur-satellite segments should be licensed in the amateur-satellite service or as an experimental station. However, that is a matter for the licensing administration. The Council agrees that it is appropriate that such satellites be coordinated, since the benefits of doing so outweigh the potential disadvantages."* The Advisory Panel has fully endorsed the position of the IARU Administrative Council and is considering every request on its merit.

In many instances the panel has been able to give guidance and technical advice from its members or other experts in the amateur satellite fraternity.

Frequencies - a Scarce Resource

Frequencies are a scarce resource and far from unlimited. While to the outsider the 70cm band may appear to be large, it should be realised that there are many other Amateur Radio services that share this spectrum. The satellite portion is limited and frequencies have to be shared. This is a difficult task. The Advisory Panel carefully considers the type of satellite, its planned orbit, lifespan and many other factors before coordinating a specific frequency.

We enjoy good cooperation from the various universities building satellites and from amateur satellite groups. This makes the panel's job a lot easier. It however remains a tough, challenging job which requires time and dedication.

SuitSat Goes to School



Mr. Lyons and one hundred 5th graders at Linton Springs Elementary School in Eldersburg, Md. welcome Mr. Pat Kilroy, N8PK, from NASA. A flier on SuitSat, a demo, a lively Q&A session and a student-produced video interview were the highlights of the morning at LSES on Monday, February 6, 2006.

The
AMSAT[®]
Journal



Early Objects in Space

A Short History of Satellite Communications

Dave Hartzell, N0TGD, hartzell@gmail.com



The Satellite Beacon

An article presented by the Project OSCAR Amateur Radio Club

It is hard to imagine a world without satellite communications. Communications satellites deliver television programming, pager messages and syndicated radio programs. But few people (including amateurs) know the history of how we came to rely on these magnificent space-birds in our daily life. For us hams, “working birds” is a technical challenge and a fascinating way to DX without having to work skip. In this article, I’m going to run down some of the early history of satellite communications.

“Futurists” had kicked around the idea of orbiting satellites way back in the late 1800s, but it took one particularly bright man to come up with the idea of putting communications relays into an orbit having a 24-hour rotational period. In 1945, science-fiction author Sir Arthur C. Clarke published his paper entitled “Extra-Terrestrial Relays” describing a communications system using three geostationary satellites that could broadcast signals, “giving constant field strength at all times over the whole globe.” Sir Arthur also envisioned the broadcast service using inter-satellite links. Not bad for 1945! Later, Clarke would coin himself the “grandfather” of satellite communications and publicly stated that he wished he patented the whole idea of geosynchronous satellite communications.

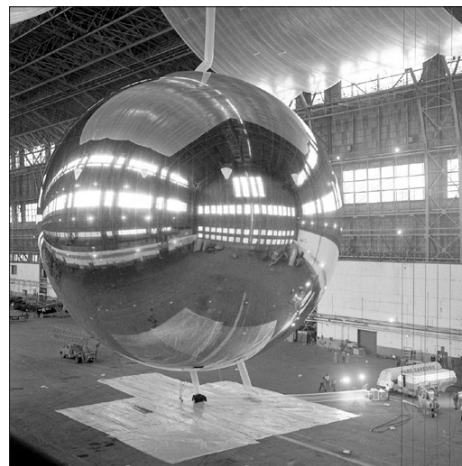
However, it took until the 1960s for satellite communications to become a reality. Knowing that the ionosphere had severe limitations, including predictability and reliability, engineers at companies like AT&T became interested in the idea of using satellites to “bridge” the Atlantic as an alternative to laying trans-oceanic cables, which were coaxial at the time (fiber didn’t come along until the 1970s). Surprisingly, the first trans-Atlantic telephone cable (TAT-1) did not bridge the gap until 1958, carrying only 36 voice circuits. A few years later, AT&T would demonstrate satellite connectivity, which would evolve into the primary link between the U.S. and Europe.

The first satellite to relay a recorded message was the Army’s Project SCORE, which in 1958 carried a message onboard from President Eisenhower. SCORE successfully worked and Ike’s Christmas message was transmitted down to Earth on 108 MHz.

SCORE was a store-and-forward system, able to record and transmit various messages after launch using magnetic tape recording and playback.

In 1960, following on the success of SCORE, NASA launched a passive relay satellite named ECHO. Simply put, ECHO was a big, shiny Mylar balloon in space. It would be great at parties! Ground stations bounced microwave signals off ECHO and, while the project was considered a success allowing engineers and scientists to test atmospheric and ionosphere properties, ECHO would not provide a solid path for reliable communications. But it sure looked cool and it was big, approximately 100 feet across when inflated.

Echo



Jumping back to the private sector, AT&T had been working on communications satellite concepts. The John F. Kennedy administration didn’t want to see the telephone monopoly monopolize the space communications sector. So Congress passed the Communications Satellite Act in 1962, which created the Communications Satellite Corporation, or COMSAT. Initially, COMSAT was the only FCC authorized entity permitted to engage in commercial satellite communications. Shares of COMSAT were sold to the public (including AT&T, GTE and other big companies interested in a cut). The COMSAT act did not prohibit AT&T from launching its own experimental communications satellite, and in 1962 Telstar 1 was launched, the first active relay satellite. Telstar 1 was small, weighing in at 170 pounds and was placed into a low-Earth orbit. The uplink was on 6.390 GHz

and 4.170 GHz was used for the downlink. In addition to carrying voice calls over the Atlantic, Telstar could also carry a television signal. The LEO orbit and the subsequent short pass-times limited Telstar’s use to short-duration experiments.

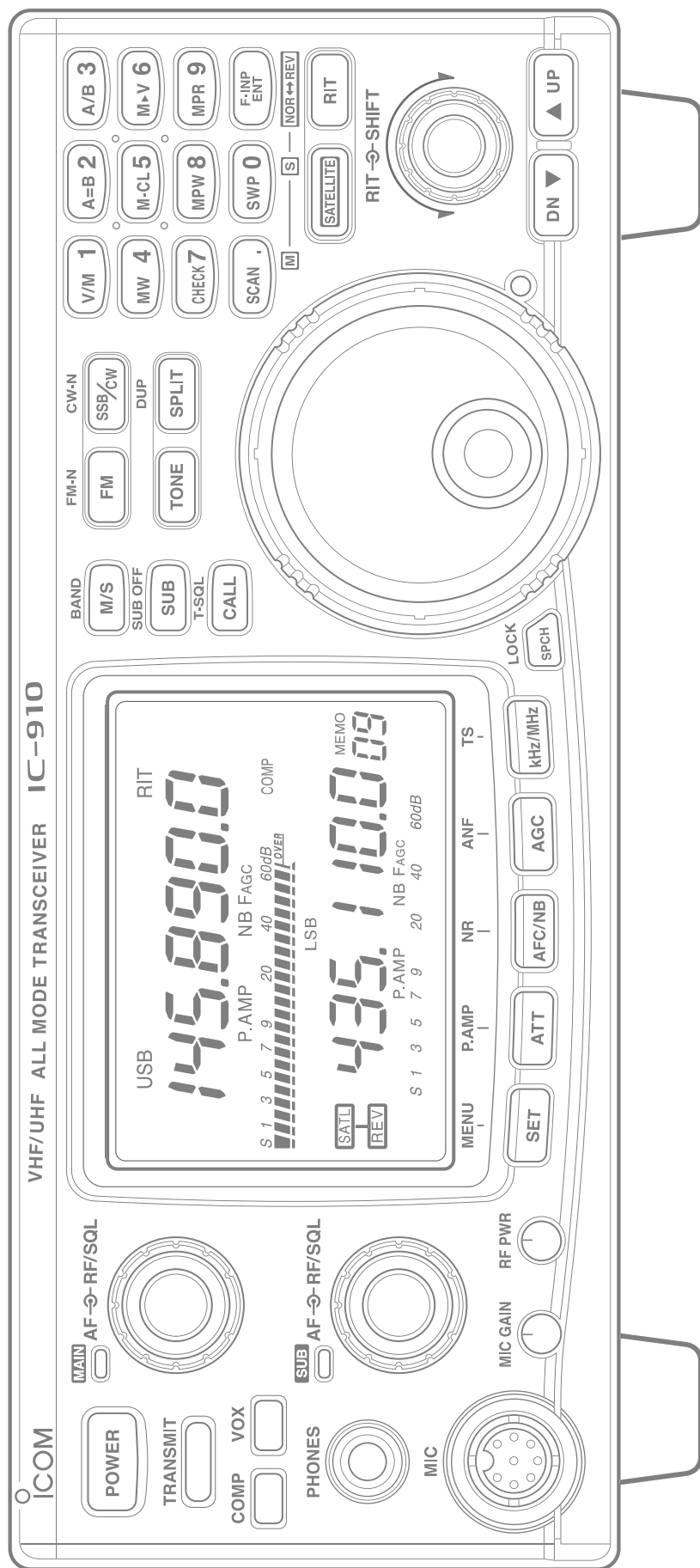
Of course, any history of satellite communications would not be complete without mentioning our amateur contributions! Right at the beginning of the Space Age, the Project OSCAR folks launched OSCAR I, II and III. Riding as ballast weight, OSCAR I and II entered space in 1961 and 1962, relaying temperature information back to Earth by varying the speed of the CW signal “HI HI.” OSCAR III launched in 1965 carrying a 2-meter linear transponder and hams around the world made 176 contacts. Clearly a good start! A few years later, AMSAT was established, and the rest might just show up as a future *Beacon* article!

In closing, I leave you with the words broadcast around the world by President Eisenhower’s first satellite message.

“This is the President of the United States speaking. Through the marvels of scientific advance, my voice is coming to you from a satellite traveling in outer space. My message is a simple one: Through this unique means I convey to you and all mankind, America’s wish for peace on Earth and goodwill toward men everywhere.” 🌐

Telstar





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AG-35

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